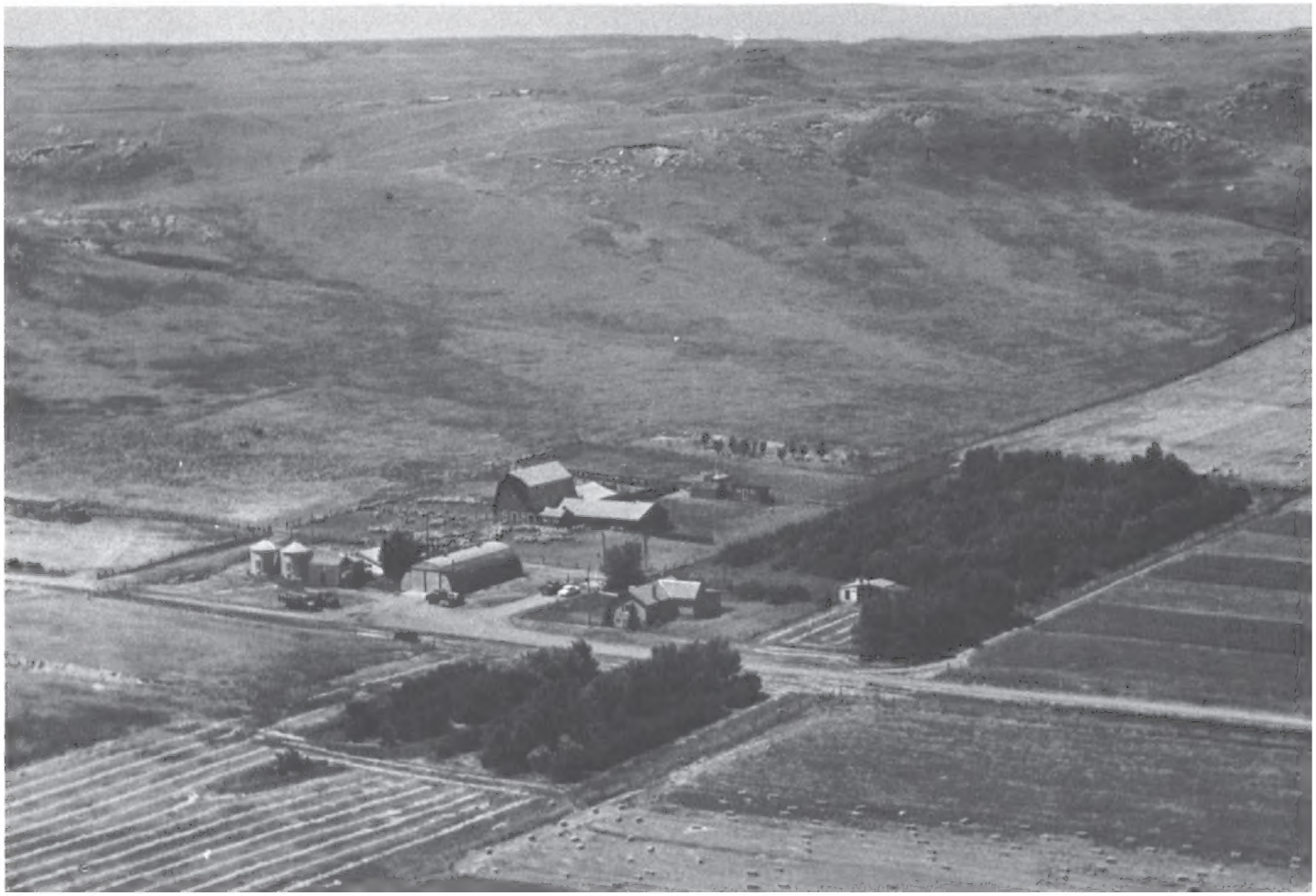
SOIL SURVEY OF

Bowman County, North Dakota



United States Department of Agriculture
Soil Conservation Service
In cooperation with
North Dakota Agricultural Experiment Station

Major fieldwork for this soil survey was done in the period 1963–66. Soil names and descriptions were approved in 1969. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1966. This survey was made cooperatively by the Soil Conservation Service and the North Dakota Agricultural Experiment Station. It is part of the technical assistance furnished to the Bowman-Slope Conservation District.

Copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Bowman County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the range site and the windbreak suitability group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, the range sites, and the windbreak groups.

Foresters and others can refer to the section "Windbreaks" where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of Soils for Wildlife."

Ranchers and others can find, under "Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain estimates of soil properties and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of Soils."

Newcomers in Bowman County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "General Nature of the County."

Cover: **Typical area in Bowman County. In the foreground is Grail silty clay loam, nearly level, which is used for small grain and hay. Windbreak gives protection to the farmstead. In the background is Cabba-Wayden-Shale outcrop complex, which is used for range.**

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SOIL SURVEY OF BOWMAN COUNTY, NORTH DAKOTA

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

BOWMAN COUNTY is in the southwest corner of North Dakota (fig. 1). It is bounded on the west by Montana, on the south by South Dakota, on the north by Slope County, and on the east by Adams County. It has an area of 744,320 acres. The climate is semiarid. Farming is the main enterprise in the county. Bowman is the county

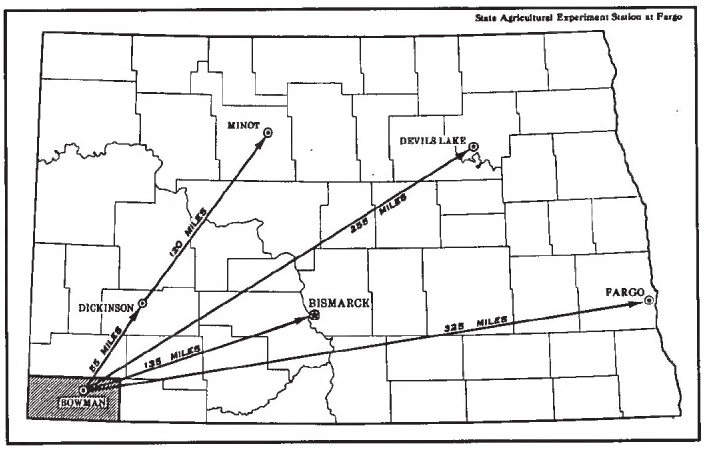

Figure 1.—**Location of Bowman County in North Dakota.**

seat. In 1960 the population of Bowman was 1,730, and the population of the county was 4,154. More detailed information about the county can be found in the section "General Nature of the County."

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Bowman County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey (*4*).[1]

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Reeder and Ekalaka, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Cherry clay loam, gently sloping, is one of three phases within the Cherry series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Bowman County: soil complexes and undifferentiated groups.

[1] Italic numbers in parentheses refer to Literature Cited, p. 138.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Reeder-Rhoades complex, gently sloping, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. Korchea and Straw soils, channeled, is an undifferentiated soil group in this county.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Badland is a land type in this county.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants, and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Bowman County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a cerain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The 15 soil associations in this survey have been grouped into four general kinds of landscapes for broad interpretative purposes. Each of the broad groups and the soil associations in each group are described in the following pages. The terms for texture used in the title for several of the associations apply to the texture of the surface layer. For example, in the title of association 1, the word, loamy refers to the texture of the surface layer.

Soils Underlain by Soft Shale; on Uplands

These associations are made up of soils that are underlain by soft bedrock. The soils formed in material weathered from soft shale, siltstone, and, in a few places, sandstone. Hills and buttes, such as Medicine Pole Hills, are in a few places. Occasional outcrops of sedimentary rock and small barren areas are on the steepest slopes. The drainage pattern consists of many intermittent streams that are deeply entrenched in some places. These associations make up about 33 percent of the county.

1. Amor-Reeder-Cabba association

Nearly level to strongly sloping, moderately deep and shallow, well-drained, loamy soils

This association consists mainly of gently sloping soils that are on plains characterized by long slopes. A few areas are rolling to hilly and have complex, short slopes.

This association occupies about 16 percent of the county. It is about 20 percent Amor soils, 15 percent Reeder soils, 10 percent Cabba soils, and 55 percent minor soils.

Amor soils have slightly convex and plain slopes. They are moderately deep and medium textured. The surface layer is dark grayish-brown loam about 8 inches thick. The subsoil is brown loam in the upper part and light brownish-gray loam in the lower part. It is underlain by stratified, soft, fine-grained sandstone and soft shale bedrock at a depth of about 31 inches.

Reeder soils have slightly convex and plain slopes. They are moderately deep and medium textured. The surface layer is dark grayish-brown loam about 8 inches thick. The subsoil is brown clay loam in the upper part and light brownish-gray loam in the lower part. It is

underlain by soft sandstone bedrock at a depth of about 23 inches.

Cabba soils have steeper, convex slopes. They are shallow and medium textured. The surface layer is grayish-brown silt loam about 3 inches thick. Below this is light brownish-gray, calcareous loam about 7 inches thick. Soft shale and soft siltstone bedrock is at a depth of about 17 inches.

Minor soils are the Arnegard, Belfield, Chama, Daglum, Flasher, Grail, Moreau, Regent, Rhoades, Vebar, and Wayden soils. Most of these are in a complex pattern in close association with Amor, Cabba, and Reeder soils. Arnegard and Grail soils are in swales and in low, concave areas.

The soils in this association are low to high in natural fertility and available water capacity and are low or moderate in organic-matter content. The main needs of management are conserving moisture, controlling water erosion, and maintaining soil fertility.

Nearly all of this association is used for small grain, alfalfa, and some corn. Wheat is the main cash crop. A few wet claypan or saline areas that are hilly and steep are used for range and as wildlife habitat. Most areas of Amor and Reeder soils are cultivated (fig. 2). Cabba soils that have slopes of less than 9 percent are suited to cultivation if erosion control practices are used. Where slopes are more than 9 percent, Cabba soils are not suited to cultivation. The main economic enterprise is diversified grain and livestock farming.

2. *Regent-Moreau-Cabba association*

Nearly level to gently sloping, moderately deep and shallow, well-drained, loamy and clayey soils

This association consists mainly of gently sloping soils on uplands. A few areas are sloping and hilly and have complex, short slopes.

This association occupies 1 percent of the county. It is about 55 percent Regent soils, 15 percent Moreau soils, 10 percent Cabba soils, and 20 percent minor soils.

Regent soils have slightly convex and plain slopes. They are moderately deep and fine textured and moderately fine textured. The surface layer is dark grayish-brown silty clay loam about 7 inches thick. The subsoil is grayish-brown silty clay in the upper part, olive silty clay in the middle part, and pale-olive silty clay in the lower part. It is underlain by soft shale bedrock at a depth of about 37 inches.

Figure 2.—**Cultivated fields in the Amor-Reeder-Cabba association: summer fallow on left and wheat on right.**

Moreau soils have slightly convex and plain slopes. They are moderately deep and fine textured. The surface layer is grayish-brown silty clay about 5 inches thick. The subsoil is light brownish-gray silty clay in the upper part, light-gray to gray silty clay in the middle part, and light-gray to gray and olive-gray silty clay in the lower part. It is underlain by soft shale bedrock at a depth of about 22 inches.

Cabba soils have steeper, convex slopes. They are shallow and medium textured. The surface layer is grayish-brown silt loam about 3 inches thick. Below this is light brownish-gray loam about 7 inches thick. It is underlain by soft shale and soft siltstone bedrock at a depth of about 17 inches.

Minor soils are the Amor, Belfield, Chama, Daglum, Grail, Morton, Savage, and Vebar soils. Most of these are in a complex pattern in close association with Cabba, Moreau, and Regent soils. Grail and Savage soils are in swales and on fans.

The soils in this association range from low to high in natural fertility and available water capacity and are low and moderate in organic-matter content. The main needs of management are controlling water erosion, conserving moisture, maintaining fertility, and maintaining or improving tilth.

The cultivated soils in this association are used for small grain, alfalfa, and some corn. Wheat is the main cash crop. Nearly all areas of the Regent and Moreau soils are cultivated and are suited to crops common to the county. Most areas of the Cabba soils are used for range. Cabba soils that have slopes of less than 9 percent are suited to cultivated crops if erosion control practices are used. Where slopes are more than 9 percent, Cabba soils are not suited to cultivation. The main economic enterprise is diversified grain and livestock farming.

3. *Cabbart-Absher association*

Hilly to steep, shallow and deep, moderately well drained and well drained, loamy soils and loamy soils that have a claypan

This association consists of hilly to steep soils and some gently sloping soils. A few bedrock outcrops are near streams.

This association occupies about 5 percent of the county. It is about 25 percent Cabbart soils, 20 percent Absher soils, and 55 percent minor soils.

Cabbart soils have convex slopes and are on the crests of ridges. They are shallow and medium textured. The surface layer is light brownish-gray silt loam about 4 inches thick. Below this is a transitional layer of light yellowish-brown silt loam about 3 inches thick. It is underlain by soft shale bedrock at a depth of about 14 inches.

Absher soils have slightly concave and plain slopes. They are deep and medium textured. They have a claypany. The surface layer is grayish-brown loam about 2 inches thick. The subsurface layer is light brownish-gray loam about 1 inch thick. The claypan subsoil is grayish-brown silty clay in the upper part and light brownish-gray silty clay that has salt masses in the lower part. It

is underlain by soft shale and siltstone bedrock at a depth of about 40 inches.

Minor soils are the Belfield, Boxwell, Chanta, Daglum, Ekalaka, Fleak, Kremlin, Marmarth, Rhame, and Yawdim soils. Most of these are in a complex pattern in close association with Absher and Cabbart soils. Chanta and Kremlin soils are on stream terraces.

The soils in this association are low in available water capacity, organic-matter content, and natural fertility. The main needs of management are controlling grazing and maintaining fertility.

The cultivated soils in this association are used for small grain, alfalfa, and some corn. Wheat is the main cash crop. Some of the deeper, less sloping areas of these soils are cultivated. Most of the association is in native grass and is used for range. The main economic enterprise is ranching.

4. Dilts-Lisam-Shale outcrop association

Gently sloping to hilly, shallow, well-drained, clayey soils and shale outcrops

This association consists of low, rounded hills and smooth-sided valleys and shale outcrops. Drainage is well established.

This association occupies about 4 percent of the county. It is about 30 percent Dilts soils, 25 percent Lisam soils, 15 percent Shale outcrop, and 30 percent minor soils.

Dilts soils are on sides and crests of hills and are shallow and fine textured. The surface layer is olive-gray clay about 5 inches thick. Below this is gray clay about 14 inches thick. The underlying material is soft shale bedrock at a depth of about 19 inches.

Lisam soils are on sides and crests of hills and are shallow and fine textured. The surface layer is grayish-brown clay about 3 inches thick. Below this is light brownish-gray and light olive-gray clay about 12 inches thick. The underlying material is soft shale bedrock.

Shale outcrop consists mainly of nearly barren shale that is exposed on buttes, cone-shaped knobs, and very steep escarpments. It is stratified with layers of soft shale, siltstone, and soft sandstone. Some areas of Shale outcrop are capped with gravel.

Minor soils are the Absher, Boxwell, Cabbart, Marmarth, Rhoades, and Yawdim soils and Alluvial land, saline. Most of these soils are in a complex pattern in close association with Dilts and Lisam soils and Shale outcrop. Alluvial land, saline, is in swales, in draws, and on fans. Rhoades and Absher soils are in a complex pattern with Alluvial land, saline.

Dilts and Lisam soils in this association are low in available water capacity, organic-matter content, and natural fertility. Dilts and Lisam soils support very little vegetation; however, some Rocky Mountain juniper and a few pines have established themselves in this association (fig. 3). The main needs of management are controlling erosion and improving range.

The soils in this association are not suited to cultivation. They are used only for grazing. The main economic enterprise is ranching.

5. Cabbart-Badland-Yawdim association

Steep to very steep, shallow, well-drained, loamy and clayey soils and badlands

This association consists mainly of steep to very steep, shallow soils and shale and sandstone outcrops. A few areas are nearly level to gently sloping.

This association occupies about 3 percent of the county. It is about 25 percent Cabbart soils, 20 percent Badland and Barren badland, 15 percent Yawdim soils, and 40 percent minor soils.

Figure 3.—**Rocky Mountain juniper in the Dilts-Lisam-Shale outcrop association.**

Cabbart soils have convex slopes and are on crests of ridges. They are shallow and medium textured. The surface layer is light brownish-gray silt loam about 4 inches thick. Below this is a transitional layer of light yellowish-brown silt loam about 3 inches thick. It is underlain by soft shale bedrock at a depth of about 14 inches.

Badland is mainly steep and very steep and is on uplands. It has been severely eroded by streams. The general topography is a series of ridges, pinnacles, domes, cones, pillars of shale capped by sandstone, and nearly vertical cliffs (fig. 4). Shale and sandstone outcrops make up 35 to 55 percent of the area. Less than 70 percent of the area of Badland has a vegetative cover.

Barren badland is steep and very steep and is on uplands. It has been severely eroded by streams. The general topography is a series of bare hills, ridges, and deep-gullied areas interspersed with level to sloping, vegetated areas. Less than 15 percent of the area has a vegetative cover.

Yawdim soils have convex slopes and are on crests of hills. They are shallow and fine textured. The surface layer is grayish-brown silty clay about 3 inches thick. Below this is light brownish-gray silty clay about 6 inches thick. It is underlain by soft shale bedrock at a depth of about 15 inches.

Minor soils are the Absher, Belfield, Boxwell, Daglum, Fleak, Marmarth, Patent, Rhame, Rhoades, and Sham soils. Most of these soils are in a complex pattern in close association with Badland and Cabbart and Yawdim soils. Sham and Patent soils are on fans and in valleys.

Cabbart and Yawdim soils in this association are low in available water capacity, organic-matter content, and fertility. The main needs of management are controlling grazing and improving range.

The soils in this association are not suited to cultivation. They are used for range and hay and as wildlife habitat. Grazing is difficult in some areas of Badland because of steepness. The main economic enterprise is ranching.

6. *Reeder-Brandenburg-Cabba association*

Gently sloping to strongly sloping, moderately deep and shallow, well-drained and excessively drained, loamy soils

This association consists of gently sloping to strongly sloping soils on plains. A few areas are hilly to very steep. Most of the hills are capped with scoria.

This association occupies 2 percent of the county. It is about 35 percent Reeder soils, 20 percent Brandenburg soils, 20 percent Cabba soils, and 25 percent minor soils.

Reeder soils have slightly convex and plain slopes. They are moderately deep and medium textured. The surface layer is dark grayish-brown loam about 8 inches thick. The subsoil is brown clay loam in the upper part and light brownish-gray clay loam in the lower part. It is underlain by soft sandstone bedrock at a depth of about 23 inches.

Brandenburg soils have slightly convex and plain slopes. They are very shallow and medium textured. The surface layer is pinkish-gray channery loam about 4 inches thick. Below this is reddish-yellow very channery loam about 6 inches thick. It is underlain by shattered porcellanite (scoria) beds at a depth of about 10 inches.

Cabba soils have convex slopes. They are shallow and medium textured. The surface layer is grayish-brown silt loam about 3 inches thick. Below this is light brownish-gray loam about 7 inches thick. It is underlain by soft shale and soft siltstone bedrock at a depth of about 17 inches.

Minor soils are the Arnegard, Belfield, Daglum, Flasher, Grail, Rhoades, Searing, Shambo, and Vebar soils. Most of these soils are in a complex pattern in close association with Brandenburg, Cabba, and Reeder soils.

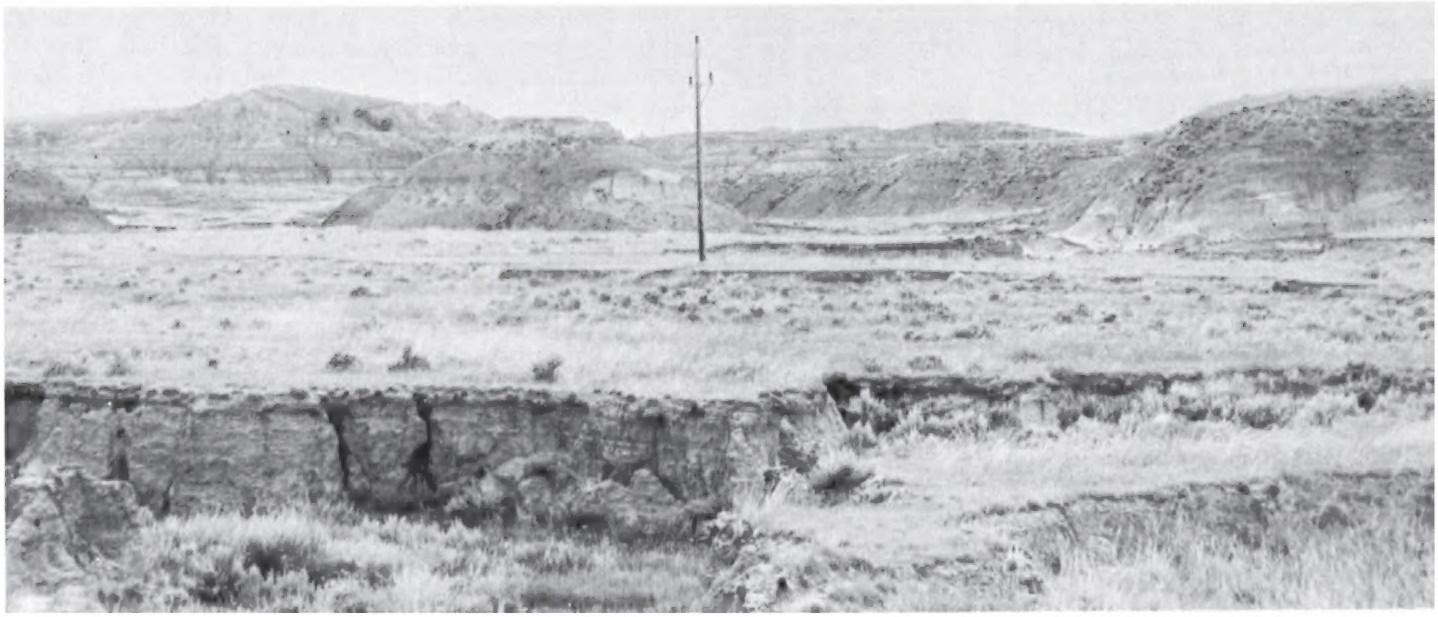

Figure 4.—**Area of eroded Sham soils. Almost barren hills and cliffs are in the background.**

Arnegard, Grail, and Shambo soils are in swales and concave positions.

The soils in this association are very low to high in available water capacity, low and moderate in organic-matter content, and low and high in natural fertility. The main needs of management are controlling grazing, conserving moisture, controlling soil blowing and water erosion, and maintaining tilth and fertility.

The cultivated soils of this association are used for small grain, corn, and alfalfa. Wheat is the main cash crop. About half of these soils are cultivated. In most places Cabba and Brandenburg soils are in native grass and used for grazing. The main economic enterprise is diversified grain and livestock farming.

7. Cabba-Amor-Chama association

Rolling to hilly, shallow and moderately deep, well-drained, loamy soils

This association consists of rolling to hilly soils. A few areas are gently sloping and steep.

This association occupies about 2 percent of the county. It is about 40 percent Cabba soils, 20 percent Amor soils, 20 percent Chama soils, and 20 percent minor soils.

Cabba soils have convex slopes. They are shallow and medium textured. The surface layer is grayish-brown silt loam about 3 inches thick. Below this is light brownish-gray loam about 7 inches thick. It is underlain by soft shale and soft siltstone bedrock at a depth of about 17 inches.

Amor soils have slightly convex and plain slopes. They are moderately deep and medium textured. The surface layer is dark grayish-brown loam about 8 inches thick. The subsoil is brown loam in the upper part and light brownish-gray loam in the lower part. It is underlain by stratified, soft, fine-grained sandstone and soft shale bedrock at a depth of about 31 inches.

Chama soils have slightly convex and plain slopes. They are moderately deep and moderately fine textured. The surface layer is dark grayish-brown silty clay loam about 6 inches thick. The subsoil is grayish-brown silty clay loam. It is underlain by soft shale bedrock at a depth of about 34 inches.

Minor soils are the Arnegard, Belfield, Dahlum, Flasher, Grail, Korchea, Reeder, Rhoades, Chambo, Stady, Tally, Vebar, and Velva soils. Most of these are in a complex pattern in close association with Amor, Cabba, and Chama soils. Korchea, Shambo, Stady, Tally, and Velva soils are on terraces and bottom lands. Arnegard and Grail soils are in swales and concave positions.

The soils in this association are low and moderate in available water capacity and organic-matter content and are low and medium in natural fertility. The main needs of management are controlling grazing, conserving moisture, controlling soil blowing and water erosion, and maintaining tilth and fertility.

The cultivated soils in this association are used for small grain, corn, and alfalfa. Wheat is the main cash crop. About 30 percent of this association is cultivated. Soils that have slopes of more than 9 percent are mainly in native grass and are used for grazing. The main economic enterprise is diversified grain and livestock farms.

Soils Underlain by Soft Sandstone; on Uplands

These associations are made up of soils that formed in material weathered from soft sandstone. Most of the soils are nearly level to gently undulating, but in some places they are hilly. Hills, capped with materials that are resistant to erosion, rise above the general level of the landscape. Many deeply entrenched intermittent streams drain the area. Barren exposures of sedimentary sandstone beds are on some of the steeper soils on sides of hills. Nearly level claypan soils are in some of the low and slightly concave areas. These associations make up about 27 percent of the county.

8. Vebar-Flasher association

Nearly level to gently undulating, moderately deep, well-drained and shallow, excessively drained, sandy and loamy soils

This association consists mainly of a gently undulating plain. A few areas are hilly and have complex, short slopes dissected by intermittent streams.

This association occupies 11 percent of the county. It is about 30 percent Vebar soils, 15 percent Flasher soils, and 55 percent minor soils.

Vebar soils are near the middle of the slopes. They are moderately deep and moderately coarse textured. The surface layer is dark grayish-brown fine sandy loam about 6 inches thick. The subsoil is grayish-brown fine sandy loam in the upper part and brown fine sandy loam in the lower part. It is underlain by soft sandstone bedrock at a depth of about 34 inches.

Flasher soils are on hilltops and crests of ridges. They are moderately coarse textured and coarse textured. The surface layer is grayish-brown fine sandy loam about 5 inches thick. Below this is light brownish-gray fine sandy loam underlain by light brownish-gray loamy fine sand. Soft sandstone bedrock is at a depth of about 12 inches.

Minor soils are the Absher, Amor, Arnegard, Belfield, Cabba, Daglum, Ekalaka, Manning, Parshall, Reeder, Rhoades, Shambo, Stady, Tally, and Telfer soils. Manning, Shambo, Stady, and Tally soils are on bottom lands and stream terraces. Arnegard and Parshall soils are in low swales and concave areas.

Vebar and Flasher soils in this association are very low and moderate in available water capacity, low and moderate in organic-matter content, and low and medium in natural fertility. The main needs of management are controlling soil blowing and maintaining tilth and fertility (fig. 5).

The cultivated soils in this association are used for small grain, corn, and alfalfa. Wheat is the main cash crop. Much of the acreage of these soils is used for cultivated crops, but a few hilly, steep, wet, claypan, or saline areas are used for range or as wildlife habitat. Most areas of Vebar soils are suited to cultivated crops if protective measures are used to control soil blowing. Flasher soils are not suited to cultivated crops. The main economic enterprise is diversified grain and livestock farming.

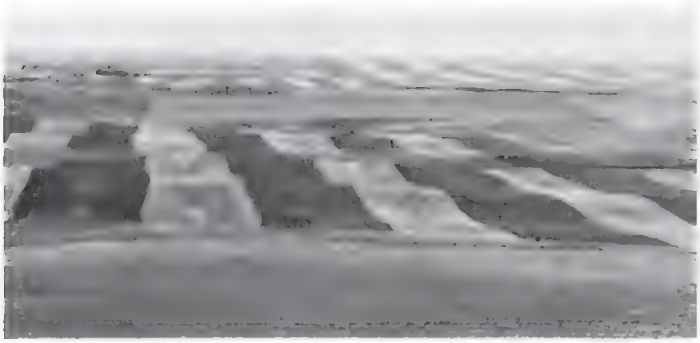

Figure 5.—Stripcropping to control soil blowing in the Vebar-Flasher association.

9. Rhame-Fleak association

Nearly level to gently undulating, moderately deep, well-drained, loamy soils, and shallow, excessively drained, sandy soils

This association consists mainly of a gently undulating plain. In places slopes are long. A few areas are hilly and have complex, short slopes. Some areas on hilltops are capped with sandstone.

This association occupies about 2 percent of the county. It is about 40 percent Rhame soils, 20 percent Fleak soils, and 40 percent minor soils.

Rhame soils are near the center of the slopes. They are moderately deep and moderately coarse textured. The surface layer is grayish-brown fine sandy loam about 8 inches thick. The subsoil is grayish-brown fine sandy loam in the upper part and light yellowish-brown fine sandy loam in the lower part. It is underlain by very soft sandstone at a depth of about 34 inches.

Fleak soils are on hilltops and crests of ridges. They are shallow and coarse textured. The surface layer is grayish-brown loamy fine sand about 3 inches thick. The subsoil is grayish-brown loamy fine sand in the upper part and light brownish gray loamy fine sand in the lower part. It is underlain by soft sandstone at a depth of about 17 inches.

Minor soils are the Arnegard, Absher, Belfield, Boxwell, Cabbart, Daglum, Ekalaka, Parshall, Rhoades, Toby, Tusler, and Zeona soils. Tusler soils make up a large part of the acreage of these minor soils. Most of these soils are in a complex pattern in close association with Fleak and Rhame soils. Arnegard, Parshall, and Toby soils are in swales and concave areas.

The soils in this association are very low and low to moderate in available water capacity, low and moderate in organic-matter content, and low and medium in natural fertility. The main needs of management are controlling soil blowing and maintaining tilth and fertility.

The cultivated soils in this association are used for small grain, alfalfa, and grass. Wheat is the main cash crop. Much of the acreage of these soils is used for cultivated crops, but a few hilly, steep, claypan, or saline areas are used for range or as wildlife habitat. Rhame soils that have slopes of less than 9 percent are suited to cultivated crops if protective measures are used. Fleak soils are not suited to cultivated crops. The main economic enterprises are the growing of cash crops and ranching.

10. Ekalaka-Rhame-Zeona association

Nearly level to gently undulating, deep and moderately deep, well-drained, loamy soils and loamy soils that have a claypan, and deep, excessively drained, sandy soils

This association consists mainly of a gently undulating plain. A few areas are hilly to steep. Outcrop and eroded areas that have rough relief are in a few places.

This association occupies about 14 percent of the county. It is about 20 percent Ekalaka soils, 15 percent Rhame soils, 10 percent Zeona soils, and 55 percent minor soils.

Ekalaka soils have slightly concave and plain slopes. They are deep and moderately coarse textured and coarse textured. They have a claypan. The surface layer is fine sandy loam about 10 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The subsurface layer is light brownish-gray loamy fine sand. The claypan subsoil is light olive-brown fine sandy loam that has salt masses in the lower part. It is underlain by stratified fine sandy loam and loamy fine sand at a depth of about 38 inches.

Rhame soils are near the center of the slopes. They are moderately deep and moderately coarse textured. The surface layer is grayish-brown fine sandy loam about 8 inches thick. The subsoil is grayish-brown fine sandy loam in the upper part and light yellowish-brown fine sandy loam in the lower part. It is underlain by very soft sandstone bedrock at a depth of about 34 inches.

Zeona soils have convex and plain slopes. They are deep and coarse textured. The surface layer is grayish-brown loamy fine sand about 6 inches thick. Below this is a transitional layer of grayish-brown loamy fine sand. It is underlain by grayish-brown loamy fine sand in the upper part, light brownish-gray and gray loamy fine sand in the middle part, and light-gray fine sand in the lower part.

Minor soils are the Absher, Boxwell, Cabbart, Daglum, Fleak, Glendive, Hanly, Havre, Korchea, Ladner, Rhoades, Kremlin, Telfer, and Rhame soils. Most of these are in a complex pattern in close association with Ekalaka, Rhame, and Zeona soils. Glendive, Hanly, Havre, Korchea, and Kremlin soils are on bottom lands and stream terraces.

The soils in this association range from very low to moderate in available water capacity, are low and moderate in organic-matter content, and are low and medium in natural fertility. The main needs of management are controlling grazing, conserving moisture, controlling soil blowing, maintaining fertility, and maintaining or improving tilth.

The cultivated soils in this association are used for small grain, corn, and alfalfa. Wheat is the main cash crop. About 35 percent of this association is used for cultivated crops. The remainder is used for range and as wildlife habitat. The main economic enterprises in this association are diversified grain and livestock farming and ranching.

Soils on Terraces and Bottom Lands

These associations are made up of nearly level, deep, loamy soils that formed in material deposited by water. Some of these soils are on bottom lands that are flooded for a short time every year. Others are on low terraces above the flood plain. A few areas are dissected by numerous stream channels. The soils are adjacent to the Little Missouri River and North Fork Grand River. These associations make up about 6 percent of the county.

11. Havre-Toby-Glendive association

Nearly level, deep, well-drained, loamy soils

This association consists of soils on bottom lands and terraces adjacent to the Little Missouri River, Little Beaver Creek, and Box Elder Creek. The soils are nearly level. Some areas adjacent to uplands are gently sloping. A few areas are steep where the river has cut escarpments.

This association occupies about 4 percent of the county. It is about 15 percent Havre soils, 15 percent Toby soils, 10 percent Glendive soils, and 60 percent minor soils.

The nearly level Havre soils are deep and medium textured. The surface layer is light brownish-gray loam about 5 inches thick. Below this is grayish-brown loam about 7 inches thick. The underlying material is grayish-brown, stratified alluvium of loam, fine sandy loam, and very fine sandy loam.

The nearly level to gently sloping Toby soils are deep and moderately coarse textured. The surface layer is grayish-brown fine sandy loam about 8 inches thick. The subsoil is brown fine sandy loam in the upper part and light olive-brown fine sandy loam in the lower part. The underlying material is grayish-brown fine sandy loam.

The nearly level to undulating Glendive soils are deep and moderately coarse textured. The surface layer is light brownish-gray fine sandy loam about 7 inches thick. The underlying material is stratified fine sandy loam, loamy fine sand, and loam.

Minor soils are the Arnegard, Boxwell, Cabbart, Chanta, Daglum, Fleak, Grail, Kremlin, Korchea, Marmarth, Rhame, Rhoades, and Zeona soils. Most of these soils are in a complex pattern in close association with Glendive, Havre, and Toby soils. Arnegard and Grail soils are in swales and concave positions. Boxwell, Cabbart, Fleak, Marmarth, and Rhame soils are on uplands.

The soils in this association are moderate to high in available water capacity, moderately low and moderate in organic-matter content, and medium in fertility. The main needs of management are controlling grazing, conserving moisture, controlling soil blowing, and maintaining tilth and fertility.

The cultivated soils in this association are used for small grain, alfalfa, and grass. About 60 percent of the acreage of these soils is suited to cultivated crops. Areas that are cut up by stream meanders and steep, choppy, eroded, claypan, and saline areas are in native grass. These soils are well suited to irrigation. The main economic enterprise in this association is ranching.

12. Korchea-Straw association

Nearly level, deep, well drained and moderately well drained, loamy soils

This association consists of soils on bottom lands and terraces along Cedar Creek and the North Fork of the Grand River and their tributaries. These soils are nearly level. Some areas adjacent to the uplands are gently sloping. A few areas are steep where the river has cut escarpments.

This association occupies about 2 percent of the county. It is about 45 percent Korchea soils, 20 percent Straw soils, and 35 percent minor soils.

The nearly level Korchea soils are deep and medium textured and moderately fine textured. The surface layer is dark grayish-brown loam about 6 inches thick. It is underlain by stratified loam, silt loam, fine sandy loam, and very fine sandy loam.

The nearly level Straw soils are deep and medium textured and moderately fine textured. The surface layer is dark grayish-brown loam. The subsoil is dark grayish-brown loam. It is underlain by grayish-brown and dark grayish-brown loam.

Minor soils are the Amor, Belfield, Cabba, Chanta, Daglum, Flasher, Reeder, Rhoades, Shambo, Stady, Tally, Vebar, and Velva soils. Most of these soils are in a complex pattern in close association with Korchea and Straw soils. Amor, Cabba, Flasher, Reeder, and Vebar soils are on uplands. Shambo, Stady, Chanta, and Tally soils are on higher terraces and alluvial fans.

The soils in this association are high in available water capacity, moderate and high in organic-matter content, and medium and high in natural fertility. The main needs of management are controlling soil blowing, conserving moisture, and maintaining tilth and natural fertility.

The cultivated soils in this association are used for small grain, corn, and alfalfa. Wheat is the main cash crop. About 70 percent of the acreage of these soils is cultivated. Where the stream meanders and the soils are steep, the areas are in native grass and are used for range and hay. These soils are well suited to irrigation and are suitable for all cultivated crops commonly grown in the county. The main economic enterprise is diversified grain and livestock farming.

Soils That Have a Claypan, Underlain by Soft Shale; on Uplands

These associations are made up of nearly level to gently sloping, loamy soils and loamy soils that have a claypan. The soils formed in stratified loamy and clayey materials from saline-alkali shale. The claypan restricts root and water penetration. In many places the claypan is so close to the surface and so dense that the soils are not suited to cultivation. The soils that have a claypan are in an intricate pattern with those that lack a claypan. Some areas are pitted with small circular depressions. Small barren or slick spots commonly are in these small, low areas. These associations make up 34 percent of the county.

13. Belfield-Rhoades-Amor association

Nearly level to gently sloping, deep and moderately deep, well drained and moderately well drained, loamy soils and loamy soils that have a claypan

This association consists mainly of gently sloping soils on a plain. A few areas are hilly and have complex, short slopes dissected by intermittent streams. In some places the local landscape is characterized by a pitted microrelief.

This association occupies about 15 percent of the county. It is about 20 percent Belfield soils, 20 percent Rhoades soils, 10 percent Amor soils, and 50 percent minor soils.

Belfield soils have mainly slightly concave and plain slopes. They are deep and medium textured. They have a claypan. The surface layer is dark grayish-brown silt loam about 8 inches thick. Beneath this is a transitional layer of light olive-gray silt loam about 4 inches. The claypan subsoil is grayish-brown silty clay loam in the upper part and light brownish-gray silty clay loam in the lower part. The underlying material is light brownish-gray clay loam.

Rhoades soils have mainly slightly concave and plain slopes. They are deep and moderately deep and medium textured. They have a claypan. The surface layer is grayish-brown loam about 3 inches thick. The subsurface layer is light brownish-gray loam about 2 inches thick. The claypan subsoil is grayish-brown silty clay and has salt masses in the lower part. It is underlain by soft shale bedrock at a depth of about 35 inches.

Amor soils have slightly convex and plain slopes. They are moderately deep and medium textured. The surface layer is dark grayish-brown loam about 8 inches thick. The subsoil is brown loam in the upper part and light brownish-gray loam in the lower part. It is underlain by stratified, soft, fine-grained sandstone and soft shale bedrock at a depth of about 31 inches.

Minor soils are the Arnegard, Cabba, Daglum, Flasher, Grail, Manning, Moreau, Reeder, Regent, Parshall, Stady, Tally, and Vebar soils. Most of these soils are in a complex pattern in close association with Amor, Belfield, and Rhoades soils. The Arnegard and Grail soils are in low swales and concave areas. The Manning, Stady, and Tally soils are on bottom lands and stream terraces.

The soils in this association are low and moderate in available water capacity, moderate in organic-matter content, and low and moderate in natural fertility. The main needs of management are conserving moisture, controlling grazing, controlling water erosion, maintaining fertility, and maintaining or improving tilth.

The cultivated soils in this association are used for small grain, alfalfa, and some corn. Wheat is the main cash crop. About 70 percent of the acreage of these soils is cultivated. Areas that are 35 percent or more Rhoades soils mainly are in native grass and are used for pasture and hay. The main economic enterprise is diversified grain and livestock farming.

14. Rhoades-Moreau association

Nearly level to gently sloping, deep and moderately deep, moderately well drained and well drained, loamy soils that have a claypan and clayey soils

This association consists of gently sloping soils on uplands. A few areas are hilly and have complex, short slopes. The local landscape is characterized by a pitted microrelief.

This association occupies about 14 percent of the county. It is about 35 percent Rhoades soils, 10 percent Moreau soils, and 55 percent minor soils.

Rhoades soils have mainly slightly concave and plain slopes. They are deep and moderately deep and medium textured. They have a claypan. The surface layer is grayish-brown loam about 3 inches thick. The subsurface layer is light brownish-gray loam about 2 inches thick. The claypan subsoil is grayish-brown silty clay and has salt masses in the lower part. Soft shale bedrock is at a depth of about 35 inches.

Moreau soils have slightly convex and plain slopes. They are moderately deep and fine textured. The surface layer is grayish-brown silty clay about 5 inches thick. The subsoil is light brownish-gray silty clay in the upper part, light-gray to gray silty clay in the middle part, and light-gray to gray and olive-gray silty clay in the lower part. It is underlain by soft shale bedrock at a depth of about 22 inches.

Minor soils are the Absher, Amor, Arnegard, Belfield, Cabba, Daglum, Ekalaka, Flasher, Grail, Korchea, Reeder, Regent, Shambo, Stady, Vebar, and Velva soils. Most of these are in a complex pattern in close association with Moreau and Rhoades soils. Arnegard and Grail soils are in swales and concave areas. Korchea, Shambo, Stady, and Velva soils are on bottom lands and stream terraces.

The soils in this association are low and moderate in available water capacity, moderate in organic-matter content, and low and medium in natural fertility. The main needs of management are controlling grazing, controlling water erosion and soil blowing, conserving moisture, maintaining fertility, and maintaining or improving tilth.

The cultivated soils in this association are used for small grain, alfalfa, and some corn. Wheat is the main cash crop. About 50 percent of the acreage of these soils is cultivated. Areas that are 35 percent or more Rhoades soils are mainly in native grass and used for pasture or hay. The main economic enterprises are diversified grain and livestock farming and ranching.

15. Rhoades-Absher association

Nearly level to gently sloping, deep and moderately deep, well drained and moderately well drained, loamy soils that have a claypan

This association consists mainly of gently sloping soils on a plain. A few areas are hilly and have complex, short slopes. The local landscape is characterized by a pitted microrelief.

This association occupies about 5 percent of the county. It is about 25 percent Rhoades soils, 20 percent Absher soils, and 55 percent minor soils.

Rhoades soils have mainly slightly concave and plain slopes. They are deep and moderately deep and medium textured. They have a claypan. The surface layer is grayish-brown loam about 3 inches thick. The subsurface layer is light brownish-gray loam about 2 inches thick. The claypan subsoil is grayish-brown silty clay and has salt masses in the lower part. It is underlain by soft shale bedrock at a depth of about 35 inches.

Absher soils have slightly concave and plain slopes. They are deep and medium textured. They have a claypan. The surface layer is grayish-brown loam about 2 inches thick. The subsurface layer is light brownish-gray loam about 1 inch thick. The claypan subsoil is grayish-brown silty clay in the upper part and light brownish-gray silty clay that has salt masses in the lower part. It is underlain by soft shale and siltstone bedrock at a depth of about 40 inches.

Minor soils are the Arnegard, Belfield, Boxwell, Cabbart, Chanta, Daglum, Fleak, Ekalaka, Grail, Glendive, Havre, Kremlin, Marmarth, Moreau, and Rhame soils. Most of these are in a complex pattern in close association with Absher and Rhoades soils. Arnegard and Grail soils are in swales and concave positions. Chanta, Glendive, Havre, and Kremlin soils are on bottom lands and stream terraces.

The soils in this association are low in available water capacity and natural fertility and low and moderate in organic-matter content. The main needs of management are controlling grazing, controlling water erosion and soil blowing conserving moisture, maintaining fertility, and maintaining or improving tilth.

The cultivated soils in this association are used for small grain, alfalfa, and some corn. Wheat is the main cash crop. About 30 percent of this association is cultivated. Areas that are 35 percent or more Rhoades and Absher soils are mainly in native grass and used for pasture or hay. The main economic enterprises in this association are livestock farming and ranching.

Descriptions of the Soils

This section describes the soil series and mapping units of Bowman County. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

The procedure is first to describe the soil series and then the mapping units in that series. The soil described as representative in the series description is representative of all the soils of the series in the county. If the soil in a mapping unit differs from the representative profile, the differences are stated in the description of the mapping unit unless the differences are apparent in the name of the mapping unit. Thus, to get full information about any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Badland and Barren badland, for example, are miscellaneous land types that do not belong to a soil series. They are listed, nevertheless, in alphabetic order along with the soil series.

In comparing a mapping unit with a soil series, many will prefer to read the short description in paragraph form. It precedes the technical description that identifies layers by A, B, and C horizons and depth range. The technical profile descriptions are mainly for soil scientists and others who want detailed information about the soils. Unless otherwise indicated, the colors given in the description are those of a dry soil. Some of the terms used to describe the soils are defined in the Glossary at the back of this survey.

TABLE 1.—*Approproximate acreage and proportionate extent of the soils*

Soil	Acres	Percent	Soil	Acres	Percent
Alluvial land, saline	2, 834	0. 4	Cabba-Amor loams, sloping	10, 744	1. 4
Alluvial land, strongly saline	4, 428	. 6	Cabba-Amor loams, hilly	13, 467	1. 8
Alluvial land, wet	321	(1)	Cabba-Wayden-Shale outcrop complex	5, 077	. 7
Amor loam, sloping	7, 543	1. 0	Cabba and Wayden stony soils	4, 640	. 6
Amor-Cabba loams, strongly sloping	1, 099	. 1	Cabbart-Boxwell loams, sloping	1, 103	. 2
Amor-Shambo loams, nearly level	3, 423	. 5	Cabbart-Boxwell loams, hilly	1, 043	. 1
Amor-Shambo loams, gently sloping	27, 369	3. 7	Cabbart complex, steep	7, 716	1. 0
Arnegard loam, nearly level	9, 247	1. 2	Cabbart-Yawdim-Shale outcrop complex	15, 344	2. 1
Arnegard loam, gently sloping	2, 556	. 3	Chama and Morton silty clay loams, nearly level	1, 807	. 2
Badland	12, 992	1. 8	Chama and Morton silty clay loams, gently sloping	8, 304	1. 1
Barren badland	1, 735	. 2	Chama, Morton, and Cabba silty clay loams, sloping	3, 430	. 5
Belfield silt loam, nearly level	9, 646	1. 3	Chanta loam, nearly level	1, 633	. 2
Belfield silt loam, gently sloping	4, 810	. 6	Chanta loam, gently sloping	320	(1)
Belfield silty clay loam, nearly level	7, 869	1. 1	Cherry clay loam, nearly level	289	(1)
Belfield silty clay loam, gently sloping	1, 995	. 3	Cherry clay loam, gently sloping	1, 024	. 1
Blown-out land	780	. 1	Cherry clay loam, sloping	517	. 1
Blown-out land-Ladner-Ekalaka complex	7, 498	1. 0	Daglum fine sandy loam, gently sloping	1, 150	. 2
Boxwell loam, sloping	617	. 1	Daglum-Rhoades loams, nearly level	968	. 1
Boxwell-Cabbart loams, strongly sloping	666	. 1	Dilts and Lisam clays, rolling	13, 061	1. 8
Boxwell-Kremlin loams, gently sloping	751	. 1	Dilts and Lisam clays, steep	9, 125	1. 2
Brandenburg-Cabba complex, hilly	6, 703	. 9			
Cabba complex, sloping	2, 751	. 4			
Cabba complex, steep	8, 898	1. 2			

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Acres	Percent
Ekalaka-Desart fine sandy loams, gently undulating	18, 368	2. 5
Ekalaka-Ladner complex, rolling	2, 822	. 4
Ekalaka-Zeona-Ladner loamy fine sands, gently sloping	10, 664	1. 4
Flasher complex, steep	1, 739	. 2
Flasher-Vebar complex, hilly	16, 480	2. 2
Flasher and Vebar very stony soils	658	. 1
Fleak-Rhame complex, hilly	13, 331	1. 8
Fleak rocky complex, steep	5, 184	. 7
Fleak-Tusler complex, steep	9, 177	1. 2
Glendive fine sandy loam, nearly level	2, 408	. 3
Glendive fine sandy loam, undulating	836	. 1
Grail silt loam, nearly level	4, 642	. 6
Grail silt loam, gently sloping	1, 018	. 1
Grail silty clay loam, nearly level	5, 082	. 7
Grail silty clay loam, gently sloping	1, 962	. 3
Grail soils, saline	719	. 1
Grail-Rhoades silty clay loams, nearly level	11, 621	1. 6
Grail-Rhoades silty clay loams, gently sloping	3, 403	. 5
Gravel pit	219	(1)
Hanly loamy fine sand	2, 707	. 4
Hanly soils, channeled	1, 522	. 2
Havre loam	2, 171	. 3
Havre clay loam	1, 523	. 2
Korchea loam	2, 624	. 4
Korchea clay loam, wet variant	683	. 1
Korchea-Havre complex	1, 217	. 2
Korchea-Straw complex	3, 810	. 5
Korchea and Havre soils, channeled	3, 733	. 5
Korchea and Straw soils, channeled	7, 658	1. 0
Kremlin loam, nearly level	1, 610	. 2
Kremlin loam, gently sloping	590	. 1
Kremlin-Belfield-Rhoades complex, nearly level	2, 208	. 3
Lawther silty clay	1, 045	. 1
Lawther-Rhoades silty clays	2, 503	. 3
Lefor-Vebar fine sandy loams, gently sloping	5, 943	. 8
Lefor-Vebar fine sandy loams, sloping	2, 577	. 3
Lehr, Manning, and Wabek soils, sloping	1, 141	. 2
Manning fine sandy loam, nearly level	2, 369	. 3
Manning fine sandy loam, gently sloping	1, 694	. 2
Marmarth loam, gently sloping	2, 336	. 3
Marmarth-Cabbart complex, sloping	1, 876	. 3
Marmarth-Rhame fine sandy loams, gently sloping	605	. 1
Marmarth-Rhame fine sandy loams, sloping	454	. 1
Marmarth-Rhoades complex, nearly level	639	. 1
Marmarth-Rhoades complex, gently sloping	5, 027	. 7
Marmarth-Rhoades complex, sloping	1, 656	. 2
Marmarth and Boxwell very stony loams	209	(1)
McKenzie silty clay	444	. 1
McKenzie and Heil silty clays	3, 020	. 4
Mine dumps	412	. 1
Moreau silty clay, nearly level	2, 048	. 3
Moreau silty clay, gently sloping	8, 875	1. 2
Moreau-Wayden silty clays, sloping	1, 722	. 2
Oburn complex	267	(1)
Parshall fine sandy loam, nearly level	1, 328	. 2
Patent loam, gently sloping	1, 158	. 2
Patent loam, sloping	702	. 1
Reeder-Cabba loams, sloping	5, 650	0. 8
Reeder-Rhoades complex, nearly level	2, 426	. 3
Reeder-Rhoades complex, gently sloping	16, 927	2. 3
Reeder-Rhoades complex, sloping	2, 475	. 3
Reeder-Shambo loams, nearly level	6, 884	. 9
Reeder-Shambo loams, gently sloping	21, 745	2. 9
Reeder and Amor very stony loams	1, 071	. 1
Regan silt loam	1, 168	. 2
Regent silty clay loam, nearly level	2, 761	. 4
Regent silty clay loam, gently sloping	6, 869	. 9
Regent-Moreau silty clay loams, sloping	1, 041	. 1
Regent-Moreau-Rhoades complex, gently sloping	6, 462	. 9
Regent-Rhoades complex, nearly level	1, 936	. 3
Rhame fine sandy loam, gently sloping	14, 938	2. 0
Rhame-Fleak fine sandy loams, sloping	3, 964	. 5
Rhame-Fleak fine sandy loams, hilly	2, 111	. 3
Rhoades-Absher complex, nearly level	25, 398	3. 4
Rhoades-Absher complex, gently sloping	49, 997	6. 7
Rhoades complex, terrace	27, 414	3. 7
Riverwash	938	. 1
Savage silty clay loam, nearly level	2, 186	. 3
Savage-Rhoades silty clay loams, nearly level	2, 775	4
Searing loam, gently sloping	1, 445	. 2
Searing loam, sloping	489	. 1
Sham soils and Gullied land	5, 239	. 7
Shambo loam, nearly level	6, 943	9
Shambo loam, gently sloping	1, 105	. 2
Shambo-Arnegard loams, nearly level	1, 884	. 3
Shambo-Arnegard loams, gently sloping	1, 599	. 2
Shambo-Belfield-Rhoades loams, nearly level	5, 244	. 7
Stady loam, nearly level	9, 857	1. 3
Stady-Lehr loams, gently sloping	3, 128	. 4
Stady-Shambo loams, nearly level	2, 226	. 3
Tally fine sandy loam, gently sloping	1, 980	. 3
Tally fine sandy loam, sloping	486	. 1
Tally-Parshall fine sandy loams, nearly level	8, 496	1 1
Telfer loamy fine sand	3, 097	. 4
Telfer-Flasher loamy fine sands, sloping	1, 005	. 1
Toby fine sandy loam, nearly level	5, 053	. 7
Toby fine sandy loam, gently sloping	1, 411	. 2
Toby fine sandy loam, sloping	330	(1)
Toby loam, nearly level	1, 952	. 3
Vebar-Flasher fine sandy loams, sloping	7, 249	1. 0
Vebar-Flasher fine sandy loams, hilly	3, 096	. 4
Vebar-Tally fine sandy loams, gently sloping	18, 802	2. 5
Velva fine sandy loam	2, 531	. 3
Wabek complex	4, 499	. 6
Watrous loam	562	. 1
Wayden-Moreau complex, sloping	1, 376	. 2
Wolf Point clay	616	. 1
Yawdim silty clay, sloping	470	. 1
Zeona fine sand, hummocky	355	(1)
Zeona fine sand, undulating	2, 270	. 3
Zeona loamy fine sand, gently sloping	6, 634	. 9
Zeona-Tusler loamy fine sands, sloping	4, 881	. 7
Water	1, 029	. 1
Intermittent lakes	113	(1)
Total	744, 320	100. 0

[1] Less than 0.05 percent.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit of the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit, range site, and windbreak suitability group in which the mapping unit has been placed. The pages on which each capability unit, range site, and windbreak suitability group are described can be found by referring to the "Guide to Mapping Units" at the back of this survey.

Absher Series

This series consists of deep, well drained and moderately well drained, nearly level to gently sloping soils on fans, terraces, and uplands. These soils formed in alluvium and in material weathered from soft shale. They have a claypan in the subsoil.

In a representative profile the surface layer is grayish-brown loam about 2 inches thick. The subsurface layer is light brownish-gray loam about 1 inch thick. The subsoil is about 21 inches thick. The upper part is grayish-brown very firm silty clay. The lower part is light brownish-gray to light yellowish-brown, firm silty clay that contains many salt masses. The underling material is light brownish-gray silty clay loam and loam about 16 inches thick, over soft shale and siltstone.

Permeability is very slow. Available water capacity, organic-matter content, and fertility are low. The very slowly permeable subsoil is penetrated by only a few plant roots, and most of these are in the cracks of the claypan.

Most areas of these soils are in pasture or range. A few small areas are cultivated, and a few areas are used for hay. In cultivated areas the surface layer is dispersed and puddled. These soils are better suited to grasses than to most other crops. They are not suited to trees. Native vegetation consists of blue grama, western wheatgrass, inland saltgrass, prickly pear, and sagebrush.

Representative profile of an Absher loam in an area of Rhoades-Absher, complex, gently sloping, in native grass, 150 feet west and 30 feet north of the southeast corner of NE¼ sec. 17, T. 132 N., R. 106 W.:

A1—0 to 2 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, thin plates parting to weak, fine, crumb structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; neutral; abrupt, smooth boundary.

A2—2 to 3 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate, thin, platy structure; hard dry, friable moist, nonsticky and nonplastic wet; neutral; abrupt, smooth boundary.

B21t—3 to 5 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; peds stained very dark grayish brown (10YR 3/2) moist; strong, medium, columnar structure parting to strong, fine, angular blocky structure; extemely hard dry, very firm moist, very sticky and very plastic wet; mildly alkaline; clear, wavy boundary.

B22t—5 to 9 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate, medium, prismatic structure parting to strong, medium, angular blocky structure; extremely hard dry, very firm moist, very sticky and very plastic wet; moderately alkaline; gradual, wavy boundary.

B3cs—9 to 24 inches, light brownish-gray (10YR 6/2) to light yellowish-brown (2.5Y 6/3) silty clay, dark grayish brown to olive brown (2.5Y 4/3) moist; strong, medium, angular blocky structure; extremely hard dry, firm moist, very sticky and very plastic wet; strong effervescence; many segregations of salts and lime; moderately alkaline; gradual boundary.

C1cs—24 to 33 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, medium, angular blocky structure; very hard dry, friable moist, sticky and plastic wet; strong effervescence; common segregations of salts and lime; strongly alkaline, diffuse boundary.

C2cs—33 to 40 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard dry, friable moist, slightly sticky and plastic wet; strong effervescence; many segregations of salts; strongly alkaline.

C3—40 to 60 inches, soft shale and siltstone.

The solum ranges from 18 to 36 inches in thickness. Visible salts are at a depth of 2 to 10 inches. Depth to paralithic contact in most places ranges from 40 to 60 inches. The total thickness of the A1 and A2 horizons is less than 4 inches. These horizons are neutral to mildly alkaline. The A1 and A2 horizons are loam, silty clay loam, or clay loam. The A2 horizon is coarser textured than the A1 horizon in places. The A1 horizon is grayish brown or light brownish gray. The A2 horizon is light brownish gray or light gray. The A horizon is absent in places. The B2 horizon is clay loam, silty clay loam, or silty clay. The structure of this horizon is moderate or strong. Peds of the B2 horizon are coated with organic stains or sand grains. The C horizon is loam, silt loam, clay loam, silty clay loam, or silty clay. The sedimentary beds are soft shale and siltstone.

Absher soils are associated with Cabbart, Ladner, and Rhoades soils. They have a claypan in the B horizon that is lacking in Cabbart soils. They are finer textured than Ladner soils. They have lighter colored A1 and A2 horizons when moist than Rhoades soils.

Alluvial Land

Alluvial land occurs mainly in level to gently sloping areas in drainageways and on fans and terraces. It consists of Alluvial land, saline; Alluvial land, strongly saline; and Alluvial land, wet.

Alluvial land, saline (Ad).—This nearly level soil is in swales and drainageways and on fans and terraces along the Little Missouri River and on some of the uplands. It consists of clayey materials washed from adjacent slopes and is dominantly silty clay or clay throughout the profile. Gypsum and salt crystals are present in most places. Many areas are long and narrow and receive extra moisture from runoff from adjacent slopes. Other areas are broad and flat. Barren, dispersed areas are common. Gullies have formed in some areas where runoff water concentrates.

The native vegetation is thickspike wheatgrass, sagebrush, western wheatgrass, green needlegrass, little bluestem, and salt-tolerant plants.

Included with this land type in mapping are small areas of Absher and Rhoades soils.

The hazard of erosion is moderate in some places and severe in others. Runoff is slow to medium, depending on the degree of slope.

All areas of this land type are used for grazing. None is suited to cultivation. The main needs of management are controlling erosion and maintaining fertility. Regulating grazing helps to improve the stands of native

grasses. Capability unit VIs–SS; Saline Lowland range site; windbreak suitability group 10.

Alluvial land, strongly saline (Ae).—This soil occurs throughout the county on terraces and fans along drainageways and on the edge of depressions and toe slopes on uplands. It consists of poorly drained, mainly level to nearly level soils that are mottled and salty throughout. The soil material commonly is loam or clay loam, but it ranges from coarse loam to silty clay. The surface layer is granular or blocky in structure. A water table is in most places. This soil is characterized by salt accumulations on the surface, barren spots, and salt-tolerant vegetation.

The native vegetation is nuttail alkaligrass, alkali cordgrass, and prairie bulrush (primary species) and some inland saltgrass, alkali muhly, western wheatgrass, mat muhly, and wild barley (secondary species).

Included with this land type in mapping are areas of claypan soils of the Rhoades and Absher series. These soils occur at the edge or on the higher parts of areas of this land type.

Most areas of this land type are used for grazing. None is suited to cultivation. Capability unit VIs–SS; Saline Lowland range site; windbreak suitability group 10.

Alluvial land, wet (Af).—This nearly level soil consists of very poorly drained soils in drainageways below springs and seeps. It consists of layers of materials that formed in alluvium. The materials vary in texture, but they are generally medium textured or moderately fine textured. The surface layer is blocky, crumb, or granular in structure. In most areas mottling is within 6 inches of the surface. Most areas are small. A high water table keeps the areas wet most of the time, and they are occasionally flooded.

The native vegetation is wetland grasses, sedges, brushes, and some salt-tolerant plants.

Included with this land type in mapping are areas of strongly saline soils.

The areas of this land type are used for grazing. Some areas have potential for use as wildlife habitat. In places wetness limits use for grazing. Capability unit Vw–WL; Wetland range site; windbreak suitability group 10.

Amor Series

This series consists of moderately deep, well-drained, nearly level to hilly soils on uplands. These soils formed in material weathered from soft, loamy shale and fine-grained sandstone.

In a representative profile the surface layer is dark grayish-brown loam about 8 inches thick. The subsoil is friable loam about 11 inches thick. The upper part is brown, and the lower part is light brownish gray. The underlying material is light-gray loam about 12 inches thick over soft, loamy sedimentary beds.

Permeability, available water capacity, and organic-matter content are moderate. Fertility is medium. Tilth is good.

Most areas of these soils are used for crops. Other areas are in native range, and green needlegrass, needle-and-thread, and blue grama are the principal species. These soils are suited to cultivated crops, trees, and grasses that are common in the county.

Representative profile of an Amor loam in an area of Amor-Shambo loams, gently sloping, in a cultivated field, 340 feet west and 180 feet north of the southeast corner of SW¼ sec. 2, T. 131 N., R. 103 W.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure parting to weak, medium and fine, crumb structure; very friable moist; many roots and pores; neutral; abrupt, smooth boundary.

B2—8 to 13 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak, coarse, prismatic structure parting to weak, coarse and medium, subangular blocky structure; friable moist; common roots; many fine pores; few stains of dark grayish brown (10YR 4/2) on faces of peds; neutral; gradual, wavy boundary.

B3—13 to 19 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky structure; friable moist; common fine roots; common fine pores; slight effervescence; mildly alkaline; gradual, wavy boundary.

C1ca—19 to 31 inches, light-gray (2.5Y 7/2) loam, grayish brown (2.5Y 5/2) moist; weak, medium, subangular blocky structure; friable moist; few fine roots; common fine pores; violent effervescence; few masses of segregated lime; moderately alkaline; gradual, wavy boundary.

C2—31 to 60 inches, pale-yellow and light-gray (2.5Y 7/3 and 5Y 7/2), stratified, soft, fine-grained sandstone and siltstone, light olive gray and light olive brown (5Y 6/2 and 2.5Y 5/3) moist; massive; friable moist; slight effervescence; moderately alkaline.

Depth to carbonates ranges from 10 to 18 inches. Depth to sedimentary beds in most places is 28 to 38 inches but ranges from 20 to 40 inches. The A horizon is grayish-brown, dark grayish-brown, or dark-brown loam or silt loam. It ranges from slightly acid to mildly alkaline. The B horizon is loam, silt loam, or very fine sandy loam. It ranges from neutral to moderately alkaline. The structure of the B2 horizon is weak or moderate. The sedimentary beds in the C horizon are soft shale and fine-grained sandstone.

Amor soils are associated with Arnegard, Cabba, Reeder, Shambo, and Vebar soils. Amor soils have a thinner, dark-colored A horizon than Arnegard soils. They have a thicker solum than Cabba soils. They have a less pronounced structure than Reeder soils. They are not so deep as Shambo soils. They have a finer textured profile than Vebar soils.

Amor loam, sloping (Ag).—This soil is on uplands. Slopes range from 6 to 9 percent. The profile of this soil is simlar to that described as representative of the series, but the surface layer is thinner.

Included with this soil in mapping are small areas of Arnegard, Cabba, Rhoades, and Vebar soils. Also included are about 1,136 acres of soils that are moderately eroded. About 40 percent of the eroded acreage appears as light-colored areas in cultivated fields. Most of the erosion has been caused by water during intense rainstorms when the soil was in summer fallow.

Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are cultivated. Controlling erosion is a necessary part of good management. This soil is suited to cultivated crops if good management practices are used. Capability unit IIIe–6; Silty range site; windbreak suitability group 3.

Amor-Cabba loams, strongly sloping (A1D).—The soils in this complex are rolling to hilly but slopes are mainly 9 to 12 percent. They are on uplands. About 60 percent is Amor loam, 25 percent is Cabba loam, and 15 percent is included soils. Amor loam has a thicker surface layer and subsoil than Cabba loam. Amor loam is near the center positions on the landscape and in concave areas. Cabba loam is on the hilltops or on the upper part of the hillsides. Slopes are convex.

The profile of the Amor soils is similar to that described as representative of the Amor series, but the surface layer and the subsoil are thinner.

The profile of Cabba soils is similar to that described as representative of the Cabba series, but it contains more fine sand or coarser material.

Included with these soils in mapping are small areas of Arnegard, Reeder, and Rhoades loams.

Runoff is rapid on the soils in this unit, and the hazard of erosion is severe.

Some areas of these soils are cultivated. These soils are suited to cultivation if good management practices are used. Control of erosion is a necessary part of good management. The soils in this complex are suited to grass. Both soils in capability unit IVe–6; Amor part in Silty range site; windbreak suitability group 3; Cabba part in Shallow range site; windbreak suitability group 10.

Amor-Shambo loams, nearly level (AmA).—The soils of this complex are on uplands. About 60 percent is Amor loam, 25 percent is Shambo loam, and 15 percent is included soils. Amor loam is not so deep as Shambo loam and is in the more convex positions on the landscape.

The profile of Amor soils is similar to the one described as representative of the Amor series, but the surface layer and the subsoil are thicker.

Shambo soils have a profile similar to the one described as representative of the Shambo series.

Included with these soils in mapping are small areas of Arnegard, Reeder, Belfield, and Rhoades loams.

Runoff generally is medium on the soils in this unit. The hazard of erosion is slight.

Most areas of these soils are cultivated. Soil blowing needs to be controlled to maintain fertility. These soils are suited to all locally grown crops. Both soils in capability unit IIc–6; Silty range site; windbreak suitability group 3.

Amor-Shambo loams, gently sloping (AmB).—The soils in this complex are on uplands (fig. 6). Slopes are mainly 3 to 6 percent. About 65 percent is Amor loam, 25 percent is Shambo loam, and 10 percent is included soils. Amor loam is not so deep as Shambo loam and is in the more convex positions on the landscape.

Amor soils have the profile described as representative of the Amor series.

Shambo soils have a profile similar to the one described as representative of the Shambo series, but in a few places these soils have less fine sand and more silt or very fine sand.

Included with these soils in mapping are small areas of Arnegard, Cabba, Rhoades, and Vebar loams. About 1,391 acres of soils that are moderately eroded are also included. About 35 percent of the eroded acreage appears as light-colored areas in cultivated fields. Most of the erosion was caused by runoff during intense rainstorms when the soils were in summer fallow.

Runoff is medium, and the hazard of erosion is slight to moderate.

Most of the acreage of these soils is cultivated. Controlling erosion is a necessary part of good management. These soils are well suited to cultivated crops if good management practices are used. Both soils in capability unit IIe–6; Silty range site; windbreak suitability group 3.

Figure 6.—**Cultivated areas of Amor-Shambo loams, gently sloping. Associated steeper Cabba soils are in the background.**

Arnegard Series

This series consists of deep, well-drained, medium-textured, nearly level to gently sloping soils on fans, on toe slopes, and in swales. Slopes in most places are nearly level, and these soils receive some runoff from higher areas. These soils formed in material washed from adjacent slopes.

In a representative profile the surface layer is dark grayish-brown loam about 13 inches thick. The subsoil is friable loam about 18 inches thick. The upper part is dark grayish brown and the lower part is grayish brown. The underlying material is pale-brown loam.

Permeability is moderate. Available water capacity, organic-matter content and fertility are high. Tilth is good.

These soils are among the most productive soils in the county. Nearly all areas of these soils are cultivated. A few areas are in native range, and western wheatgrass, green needlegrass, and blue grama are the principal species. These soils are suited to cultivated crops, trees, and grasses common to the county. Trees grow well on these soils.

Representative profile of Arnegard loam, nearly level, in a cultivated field, 165 feet south and 170 feet east of northwest corner of sec. 28, T. 132 N., R. 103 W.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate, coarse and medium, subangular blocky structure parting to moderate, medium and fine, crumb structure; hard dry, friable and very friable moist, slightly sticky and nonplastic wet; neutral; abrupt, smooth boundary.

A12—7 to 13 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, coarse, prismatic structure parting to moderate, coarse and medium, subangular blocky structure; slightly hard dry, very friable moist, slightly sticky and nonplastic wet; neutral; clear, wavy boundary.

B21—13 to 23 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse and medium, prismatic structure parting to moderate, medium and fine, subangular blocky structure; hard dry, friable moist, sticky and slightly plastic wet; neutral; abrupt, wavy boundary.

B3ca—23 to 31 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate, coarse, and medium, prismatic structure parting to moderate, coarse, subangular blocky structure; hard dry, friable moist, slightly sticky and slightly plastic wet; strong effervescence; common segregations of calcium carbonate; moderately alkaline; clear, wavy boundary.

C1—31 to 60 inches, pale-brown (10YR 6/3) loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse and medium, subangular blocky structure; slightly hard dry, slightly sticky and nonplastic wet; strong effervescence; moderately alkaline.

The solum ranges from 20 to 40 inches in thickness. Depth to carbonates ranges from 16 to 45 inches. The A horizon is dark grayish-brown or very dark grayish-brown silt loam or loam. It ranges from 10 to 20 inches in thickness and is slightly acid to neutral. The B horizon is grayish-brown or dark grayish-brown loam or silt loam. It ranges from neutral to moderately alkaline. The structure of the B horizon is weak or moderate.

Arnegard soils are associated with Amor, Grail, Parshall, Rhame, Shambo, and Vebar soils. They have a coarser textured subsoil than Grail soils. They are finer textured than Parshall soils. They are darker colored to a greater depth than the nearby Amor and Shambo soils. They are deeper than the moderately deep Rhame and Vebar soils. Arnegard soils associated with the Vebar and Parshall soils have coarser textured A and B horizons than those associated with the Amor and Shambo soils. Arnegard soils near Rhame contain some porcellanite fragments.

Arnegard loam, nearly level (ArA).—This soil is on fans and in swales. Most areas are long and narrow. They receive extra moisture in the form of runoff from adjacent slopes. In places, small gullies have formed where runoff water has concentrated. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Grail silt loam, Grail soils, saline, and Belfield and Rhoades loams.

Runoff is slow on this Arnegard soil, and the hazard of erosion is slight. This soil is resistant to soil blowing, but protective measures are needed to maintain organic-matter content and fertility.

Most areas of this soil are cultivated. Only a few scattered areas remain in native grasses. This soil is well suited to cultivated crops. Capability unit IIc–6; Overflow range site; windbreak suitability group 1.

Arnegard loam, gently sloping (ArB).—This soil is in swales, in drainageways, and on foot slopes on uplands. Slopes are mainly 3 to 6 percent. The profile of this soil is similar to the one described as representative of the series, but the surface layer is thinner.

Included with this soil in mapping are small areas of Shambo and Boxwell loams, Grail soils, saline, and Belfield and Rhoades soils.

Runoff is medium on this Arnegard soil, and the hazard of erosion is slight. In some areas, however, small gullies have formed where runoff water has concentrated. The main needs of management are controlling water erosion and conserving moisture.

Most areas of this soil are cultivated. Only a few scattered areas remain in native grasses. This soil is suited to cultivated crops commonly grown in the county. Capability unit IIe–6; Silty range site; windbreak suitability group 1.

Badland

Badland (Bd) consists of soft bedrock outcrops of shale and sandstone and of soils that are mainly shallow to soft bedrock. Most areas are in the western one-third of the county. Slopes range from 3 to 50 percent.

This land type occurs partly as cone-shaped knobs, buttes, escarpments, and walls that are partially stabilized by vegetation and partly as vegetated basins where gullies, at close intervals, have cut through areas that are nearly level to strongly sloping. Erosion is active. About 15 to 70 percent of this unit has vegetation.

This land type is about 45 percent outcrops, 40 percent Cabbart, Yawdim, Fleak, and Tusler soils, and 15 percent other soils. Outcrops are mainly very steep on the sides and crests of ridges. Cabbart, Yawdim, Fleak, and Tusler soils mainly occupy the steep positions and tops of knobs, buttes, and escarpments.

Badland has some value for grazing, but areas in grass are small and scattered. Some of the steeper areas are not accessible for grazing. This land type is mainly used for range and as wildlife habitat, but some areas in swales are used for hay. The terrain provides protection from

blizzards for grazing animals and habitat for deer, antelope, and upland birds. Regulating grazing helps to control erosion. Capability unit VIIs–1; range site not assigned; windbreak suitability group 10.

Barren Badland

Barren badland (Bb) consists mainly of knobs, buttes, escarpments, walls, gullied areas, and eroded floors (fig. 7). Most of it is in the western one-third of the county. A few areas of shallow and moderately deep soils are on hillsides and hilltops. Also, a few small areas of Absher, Belfield, Boxwell, Cherry, Daglum, Marmarth, Moreau, Patent, Rhoades, and Sham soils are in valleys and swales and on side slopes below steeper positions. Erosion is active. Less than 15 percent of this unit has vegetation. The vegetation is mainly on smooth, round hills and on mesas, in valleys and swales, and on side slopes below steeper areas.

Barren badland has little value for grazing because the areas in grass are very small and scattered. Most of the steeper areas are not accessible for grazing. This land type has some value as wildlife habitat and range. Regulating grazing helps to control erosion. Capability unit VIIIe; range site not assigned; windbreak suitability group 10.

Belfield Series

This series consists of deep, well-drained, nearly level to sloping soils on fans, in swales, and on terraces and uplands. These soils formed in alluvium and in material derived from alkaline shale. They have a claypan.

In a representative profile the surface layer is dark grayish-brown silt loam about 8 inches thick. The subsurface layer is light olive-gray silt loam about 4 inches thick. The subsoil is very firm silty clay loam about 19 inches thick. The upper part is grayish brown, and the lower part is light brownish gray. The underlying material is light brownish-gray clay loam.

Permeability is moderately slow. Available water capacity and organic-matter content are moderate. Fertility is medium. The saline and alkaline conditions in the lower part of the subsoil and in the underlying material limit the availability of plant nutrients.

These soils are used for pasture and crops. The soils are tilled where they occur with a few scattered areas of Rhoades and Daglum soils. Where they occur in areas that have a high percentage of Rhoades and Absher soils, they are used for grazing. The native vegetation consists mainly of blue grama and western wheatgrass and of some green needlegrass and a few forbes and sedges.

Representative profile of Belfield silt loam, nearly level, in native grass, 202 feet east and 408 feet north of the southwest corner of NW¼ sec. 36, T. 129 N., R. 100 W.:

A1—0 to 8 inches, dark grayish-brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate, medium, prismatic structure parting to weak, medium and fine, crumb structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; slightly acid; clear, broken boundary.

A&B—8 to 12 inches, light olive-gray (5Y 6/2) silt loam, dark olive gray (5Y 3/2) moist; weak, medium, prismatic structure parting to moderate, coarse and medium, angular blocky and weak, coarse, platy structure; very hard dry, very firm moist, slightly sticky and slightly plastic wet; slightly acid; clear, wavy boundary.

Figure 7.—**Barren badland in western Bowman County.**

B21t—12 to 16 inches, grayish-brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate, medium, prismatic structure parting to moderate, coarse, and medium, angular blocky structure; very hard dry, very firm moist, sticky and plastic wet; neutral; abrupt, smooth boundary.

B22t—16 to 31 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure parting to strong, coarse and medium, angular blocky structure; very hard dry, very firm moist, plastic and sticky wet; slight effervescence; segregations of nodular lime; mildly alkaline; abrupt, smooth boundary.

C1—31 to 34 inches, light brownish-gray (2.5Y 6/2) clay loam; dark grayish brown (2.5Y 4/2) moist; strong, coarse and medium, subangular blocky structure; very hard dry, very firm moist, sticky and plastic wet; strong effervescence; segregations of nodular lime; moderately alkaline; abrupt, wavy boundary.

C2—34 to 60 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; very hard dry, firm moist; violent effervescence; moderately alkaline.

The solum ranges from 23 to 45 inches in thickness. Depth to carbonates ranges from 16 to 30 inches. Depth to sedimentary beds in most places is 44 to 56 inches, but it ranges from 40 to 60 inches. The A horizon is grayish-brown or dark grayish-brown loam, silt loam, clay loam, or silty clay loam. It ranges from slightly acid to neutral. The A&B horizon ranges from 2 to 6 inches in thickness. In places there is a thin A2 horizon. The B2 horizon is clay loam, silty clay loam, or silty clay. It ranges from neutral to moderately alkaline. The structure of the B horizon is weak, moderate, or strong. In places salt masses are concentrated in the lower part of the B horizon. In places the C horizon is mottled.

Belfield soils are associated with Rhoades, Daglum, and Shambo soils. Belfield soils lack the columnar structure in the B21t horizon of Rhoades and Daglum soils and salt concentrations are deeper in the profile than in those soils. They have a light-colored A&B horizon that is absent in Shambo soils.

Belfield silt loam, nearly level (BeA).—This soil is on fans, terraces, and uplands and in swales. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Rhoades, Daglum, Shambo, Kremlin, Grail, Reeder, and Marmarth silt loams. A pitted microrelief occurs where this soil has inclusions of Rhoades soils.

Runoff is slow to medium, and the hazard of erosion is slight. In places where included Rhoades and Daglum soils occur, low available water capacity, subsoil salinity, a claypan, and poor tilth are the main limitations. The effects of these limitations are more pronounced in years of below-normal rainfall.

Most of this soil is cultivated. This soil is suited to crops common to the county, but it is better suited to wheat, barley, and oats than to most other crops. Management practices that maintain organic-matter content and fertility and that maintain or improve tilth are needed. Capability unit IIIs–P; Clayey range site; windbreak suitability group 4.

Belfield silt loam, gently sloping (BeB).—This soil is on fans and uplands and in swales. Slopes are 3 to 6 percent. The profile of this soil is similar to the profile described as representative of the series, but it has a thinner surface layer.

Included with this soil in mapping are small areas of Rhoades, Daglum, Shambo, Kremlin, Grail, Reeder, and Marmarth silt loams.

Runoff is medium. The hazard of erosion is slight to moderate. In places where included Rhoades and Daglum soils occur, low available water capacity, subsoil salinity, a claypan, and poor tilth are the main limitations. The effects of these limitations are more pronounced in years of below-normal rainfall.

Most of this soil is cultivated. This soil is suited to crops comonly grown in the county, but it is better suited to wheat, barley, and oats than to most other crops. Management practices that help to control water erosion, that maintain organic-matter content and fertility, and that maintain or improve tilth are needed. Capability unit IIIe–P; Clayey range site; windbreak suitability group 4.

Belfield silty clay loam, nearly level (BfA).—This soil is on fans, terraces and uplands and in swales. The profile of this soil is similar to that described as representative of the series, but the surface layer is silty clay loam.

Included with this soil in mapping are small areas of Rhoades, Daglum, Savage, and Grail silty clay loams. A pitted microrelief occurs where this soil has inclusions of Rhoades soils.

Runoff is slow to medium, and the hazard of erosion is slight. In places where included Rhoades and Daglum soils occur, low available water capacity, subsoil salinity, a claypan, and poor tilth are the main limitations. The effects of these limitations are more pronounced in years of below-normal rainfall.

Most of this soil is cultivated. This soil is suited to crops commonly grown in the county, but it is better suited to wheat, barley, and oats than to most other crops. Management practices that maintain organic-matter conent and fertility and that maintain or improve tilth are needed. Capability unit IIIs–P; Clayey range site; windbreak suitability group 4.

Belfield silty clay loam, gently sloping (BfB).—This soil is on fans and uplands and in swales. Most areas have slopes of 3 to 6 percent but slopes range from 3 to 9 percent. The profile of this soil is similar to the one described as representative of the series, but the surface layer is finer textured.

Included with this soil in mapping are small areas of Regent, Rhoades, Daglum, Savage, and Grail silty clay loams. Also included are a few areas of Belfield silty loam that has slopes of 6 to 9 percent. A pitted microrelief occurs where this Belfield soil has inclusions of Rhoades soils.

Runoff is medium, and the hazard of erosion is moderate. Water erosion is the main hazard. In places where included Rhoades and Daglum soils occur, low available water capacity, subsoil salinity, a claypan, and poor tilth are the main limitations. The effects of these limitations are more pronuonced in years of below-normal rainfall.

Most areas of this soil are cultivated. This soil is suited to crops commonly grown in Bowman County, but it is better suited to wheat, barley, and oats than to most other crops. Management practices that help to control water erosion, that maintain organic-matter content and fertility, and that maintain or improve tilth are needed. Capability unit IIIe–P; Clayey range site; windbreak suitability group 4.

Blown-Out Land

Blown-out land (Bh) consists of areas of Blown-out land and of the soils in the Blown-out land-Ladner-Ekalaka complex. It is about 40 percent severely eroded, coarse-textured soils; 45 percent moderately eroded and slightly eroded, coarse-textured and moderately coarse textured soils; and 15 percent other soils. It is in scattered areas throughout the county. Most of the soil is removed from crests and knolls, and sandstone is exposed in places. Sand drifts are common along fence lines or field edges. Blown-out land is dominantly gently undulating to undulating. Most areas are cultivated, but some areas are seeded to grass.

This soil is suited to permanent grasses. Areas that do not have a good vegetative cover need to be seeded and managed to protect adjacent areas from drifting sand. Capability unit VIe–TSa; Thin Sands range site; windbreak suitability group 10.

Blown-Out Land-Ladner-Ekalaka Complex

Blown-out land-Ladner-Ekalaka complex (Bk) is about 40 percent Blown-out land, 18 percent Ladner fine sand and fine sandy loam, 16 percent Ekalaka loamy fine sand and fine sandy loam, 16 percent Telfer and Zeona loamy fine sands, and 10 percent other soils. The soils in this complex are nearly level to strongly sloping and are on uplands, mainly in the western part of the county. Slopes are mainly gently sloping and sloping. This complex is characterized by blowouts, dispersed spots, gullies, irregular areas of exposed alkaline sandstone, and soils that have a sandy surface layer. Active erosion has cut many deep gullies that leave islands of grass-covered Ekalaka, Ladner, Telfer, and Zeona soils. The gullies range from 1 to 8 feet in depth and from 3 to 30 feet in width. They have almost no vegetative cover.

The profile of Ladner soils is simlar to that described as representative of the Ladner series, except that in places the surface layer is finer textured.

The profile of Ekalaka soils is similar to that described as representative of the Ekalaka series, but the surface layer is coarser textured.

These soils are suited only to grazing and wildlife habitat. Erosion is a concern of management if the soils are overgrazed or tilled. Management practices that maintain a good grass cover and fertility are needed. All soils in capability unit VIIs–Cp; Blown-out part in windbreak suitability group 10; Ladner part in Claypan range site; windbreak suitability group 9; Ekalaka part in Sandy range site; windbreak suitability group 9.

Boxwell Series

This series consists of moderately deep, well-drained, gently sloping to hilly soils on uplands. These soils formed in material weathered from soft shale and very fine-grained sandstone.

In a representative profile the surface layer is brown loam about 6 inches thick. The subsoil is friable loam about 13 inches thick. The upper part is brown, and the lower part is pale brown. White segregated carbonates are in the lower part. The underlying material is light brownish-gray and light yellowish-brown loam about 15 inches thick over soft sedimentary beds.

Permeability, available water capacity, and organic-matter content are moderate. Fertility is medium. Tilth is good.

Boxwell soils are used for crops. Some areas are in native grass, and green needlegrass, needle-and-thread, and blue grama are the principal species. These soils are suited to cultivated crops and grasses that are common in the county.

Representative profile of a Boxwell loam in an area of Boxwell-Kremlin loams, gently sloping, in a cultivated field, 1,450 feet south and 1,860 feet east of the northwest corner of sec. 23, T. 129 N., R. 104 W.:

Ap—0 to 6 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak, medium, subangular blocky structure parting to weak, fine, crumb structure; hard dry, friable moist, slightly sticky and slightly plastic wet; many roots and fine pores; neutral; abrupt, smooth boundary.

B21—6 to 11 inches, brown (10YR 5/3) loam, brown to dark brown (10YR 4/3) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky structure; hard dry, friable moist, slightly sticky and slightly plastic wet; common fine roots and pores; neutral; clear, wavy boundary.

B22—11 to 19 inches, pale-brown (10YR 6/3) loam, brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky structure; hard dry, friable moist, slightly sticky and slightly plastic wet; common roots; common fine pores; slight effervescence; mildly alkaline; clear, wavy boundary.

C1Ca—19 to 25 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky structure; hard dry, friable moist, slightly sticky and slightly plastic wet; common to few roots; common fine pores; few fine lime nodules and threads; violent effervescence; moderately alkaline; clear, wavy boundary.

C2Ca—25 to 34 inches, light yellowish-brown (2.5Y 6/3) loam, light olive brown (2.5Y 5/4) moist; moderate, medium and fine, subangular blocky structure; hard dry, friable moist, slightly sticky and slightly plastic wet; few fine roots and pores; many soft white lime nodules; violent effervescence; moderately alkaline; gradual boundary.

C3—34 to 60 inches, pale-yellow (2.5Y 7/3) strata of soft sedimentary beds, weathered in upper part, light olive brown (2.5Y 5/3) moist; massive; hard and brittle dry; strong effervescence; moderately alkaline.

The solum ranges from 15 to 27 inches in thickness. Depth to carbonates ranges from 10 to 26 inches. Depth to sedimentary beds in most places is 27 to 37 inches, but it ranges from 20 to 40 inches. The A horizon is grayish-brown or brown loam, silt loam, and very fine sandy loam. It ranges from slightly acid to mildly alkaline in reaction. The B horizon is loam, silt loam, or very fine sandy loam. It ranges from neutral to moderately alkaline in eaction. The structure of the B horizon is weak or moderate. The C horizon is loam and soft shale and very fine grained sandstone.

Boxwell soils are associated with Cabbart, Marmarth, Kremlin, and Rhame soils. Boxwell soils are deeper than Cabbart soils. They have a less pronounced structure than Marmarth soils. They have sedimentary beds at a shallower depth than Kremlin soils. They are finer textured than Rhame soils.

Boxwell loam, sloping (BoC).—This soil is on uplands. Slopes are mainly 6 to 9 percent. The profile of this soil is similar to that described as representative of the series, but it has a thinner surface layer.

Included with this soil in mapping are small areas of Arnegard, Cabbart, Rhoades, Absher, and Rhame soils. Also included are 50 acres of moderately eroded soils. About 45 percent of the acreage of eroded soils appears as light-colored areas in cultivated fields. Most of the erosion has been caused by runoff during intense rainstorms when the soil was in summer fallow.

Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are cultivated. Controlling erosion is a necessary part of good management. Under good management, this soil is suited to cultivated crops. Capability unit IVe–6; Silty range site; windbreak suitability group 3.

Boxwell-Cabbart loams, strongly sloping (BrD).—The soils in this complex are rolling to hilly and are on uplands. Most slopes are 6 to 9 percent. About 60 percent is Boxwell loam, 25 percent is Cabbart loam, and 15 percent is included soils. Boxwell loam has a thicker surface layer and subsoil than Cabbart loam. Boxwell loam is in the middle concave positions on the landscape. Cabbart loam is on the hilltops or in the higher convex positions.

The profile of Boxwell soils is similar to that described as representative of the Boxwell series, but the surface layer and subsoil are thinner.

The profile of the Cabbart soils is similar to that described as representative of the Cabbart series, but it contains more fine sand or coarse material.

Included with this complex in mapping are small areas of Rhame fine sandy loam, small areas of Arnegard loam, and a few small areas where the soils are moderately eroded. Also included in a few places are small areas of Marmarth loam, strongly sloping, and Boxwell loam, steep.

Runoff is rapid, and the hazard of erosion is severe.

These soils are used for crops and pasture. They are better suited to grasses and pasture than to most other uses. Water erosion is a concern if the soils are overgrazed or tilled. Management practices that maintain good grass cover and fertility are needed. Both soils in capability unit VIe–Si; Boxwell part in Silty range site; windbreak suitability group 3; Cabbart part in Shallow range site; windbreak suitability group 10.

Boxwell-Kremlin loams, gently sloping (BtB).—The soils in this complex are on uplands. In most places slopes are 3 to 6 percent but range from 0 to 6 percent. About 65 percent is Boxwell loam, 25 percent Kremlin loam, and 10 percent other soils. Boxwell loam is not so deep as Kremlin loam, and in most areas it is more sloping.

The profile of Boxwell soils is similar to the one described as representative of the Boxwell series, but in a few places it contains less fine sand and more silt or very fine sand.

The profile of Kremlin soils is similar to the one described as representative of the Kremlin series, but in a few places it contains less fine sand and more silt or very fine sand.

Included with these soils in mapping are small areas of Marmarth loam, Rhame fine sandy loam, and Rhoades and Arnegard loams. Also included are 90 acres of nearly level Boxwell and Kremlin loams.

Runoff is medium, and the hazard of erosion is slight to moderate. Controlling water erosion is a necessary part of good management.

Most areas of these soils are cultivated. These soils are suited to cultivated crops if good management practices are used. Both soils in capability unit IIIe–6; Silty range site; windbreak suitability group 3.

Brandenburg Series

This series consists of shallow, excessively drained, hilly soils on uplands. These soils formed in porcellanite (locally called scoria) beds.

In a representative profile the surface layer is pinkish-gray channery loam about 4 inches thick. Below this layer is very friable, reddish-yellow very channery loam, about 6 inches thick, that is more than 50 percent porcellanite. Shattered porcellanite beds begin at a depth of 10 inches and extend to a depth of 60 inches.

Permeability is rapid. Available water capacity is very low. Organic-matter content and fertility are low.

Most areas of these soils are in native grasses that include needle-and-thread, western wheatgrass, and blue grama. These soils are not suited to cultivated crops. In places small areas are cultivated along with larger areas of associated Searing soils.

Representative profile of a Brandenburg channery loam in an area of Brandenburg-Cabba complex, hilly, in native grass, on east road cut, 1,485 feet north of southwest corner of sec. 33, T. 132 N., R. 101 W.:

A1—0 to 4 inches, pinkish-gray (7.5YR 6/2) channery loam, brown (7.5YR 4/2) moist; moderate, fine, granular structure; slightly hard dry, very friable moist; many fine roots; 15 to 30 percent small porcellanite chips; slight effervescence; mildly alkaline; clear, wavy boundary.

C1—4 to 10 inches, reddish-yellow (5YR 6/6) very channery loam, yellowish red (5YR 4/6) moist; weak, medium and fine, subangular blocky structure; soft dry, very friable moist; more than 50 percent porcellanite, thin lime crusts on underside; strong ecervescence; moderately alkaline; clear boundary.

R—10 to 60 inches, shattered porcellanite beds, slightly weathered in upper 2 to 10 inches; strong effervescence; moderately alkaline.

Depth to the porcellanite or clinker beds ranges from 10 to 20 inches. The A horizon is pinkish gray, dark brown, brown, reddish gray, and reddish brown and is 3 to 6 inches thick. It is neutral to mildly alkaline. The A horizon is channery or gravelly loam, loam, or silt loam. The C horizon is reddish-brown, reddish-yellow, or yellowish-red channery or very channery loam. It contains 20 to 75 percent clinker or porcellanite chips. The C hoizon is underlain by porcellanite or clinker beds. The porcellanite beds generally are strongly effervescent, but in places the beds are not effervescent. In places the porcellanite beds are slightly fractured and resemble bedrock; in others they are broken into small fragments and are as porous as coarse gravel.

Brandenburg soils are associated with Searing and Cabba soils. Brandenburg soils lack the B horizon of Searing soils. They have porcellanite beds in the R layer that are lacking in Cabba soils.

Brandenburg-Cabba complex, hilly (BuD).—The soils in this complex are gently sloping to very steep. Slopes range from 3 to 40 percent. They are on uplands. Most of these soils occupy knobs, cone-shaped hills and ridges that have considerable clinkers (fig. 8) and porcellanite

Figure 8.—**Clinkers in an area of Bradenburg soils.**

outcrop. About 40 percent of this complex is Brandenburg channery loam, loam, and silt loam; 30 percent is Cabba loam and silt loam; and 30 percent is included soils. Brandenburg soils are on the caps and crests of hills and in the higher convex positions on the landscape. Cabba soils are below the porcellanite beds.

Included with these soils in mapping were small areas of Searing, Reeder, Shambo, and Rhoades loams.

Most of the acreage of these soils is in grasses. In places the soils are cultivated, mainly in small tracts along with soils that are better suited to cultivation. Several areas are mined, and the porcellanite is used as surfacing material on private and secondary roads. Runoff is excessive. Both soils in capability unit VIIs–VS; Brandenburg part in Very Shallow range site; windbreak suitability group 10; Cabba part in Shallow range site; windbreak suitability group 10.

Cabba Series

This series consists of shallow, well-drained, gently sloping to very steep soils on uplands. These soils formed in material weathered from soft shale, siltstone, and fine-grained sandstone.

In a representative profile the surface layer is grayish-brown silt loam about 3 inches thick. Below this is friable, light brownish-gray silt loam about 7 inches thick. The underlying material, about 7 inches thick, is light yellowish-brown and pale-yellow silt loam that is underlain by sedimentary beds of pale-yellow shale and siltstone.

Permeability is moderate. Available water capacity, organic-matter content, and fertility are low.

Most areas of these soils are in native grasses, including needlegrass, western wheatgrass, blue gramma, needle-and-thread, and little bluestem. Where slopes are mainly less than 9 percent, the areas are cultivated along with larger areas of associated Amor, Chama, Morton, and Reeder soils. Cabba soils are better suited to grasses than to other crops. In most areas slope is more than 9 percent, and the areas are too steep for cultivated crops.

Representative profile of a Cabba silt loam in an area of Cabba complex, steep, in native grass, 55 feet west and 180 feet south of the northeast corner of SE¼ sec. 24, T. 131 N., R. 99 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; weak, fine, subangular blocky structure and weak, fine, crumb structure; hard dry, friable moist, slightly sticky and slightly plastic wet; many roots and fine pores; slight effervescence; mildly alkaline; clear, smooth boundary.

C1ca—3 to 10 inches, light brownish-gray (2.5Y 6/2) silt loam, grayish brown (2.5Y 5/2) moist; weak, coarse, prismatic structure parting to weak, medium and fine, subangular blocky structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; many roots; common fine pores; common, light-gray soft nodules of lime; violent effervescence; moderately alkaline; clear, wavy boundary.

C2—10 to 17 inches, light yellowish-brown (2.5Y 6/3) and pale-yellow (2.5Y 7/3) silt loam, grayish brown (2.5Y 5/2) moist; weak, coarse and medium, subangular blocky structure parting to weak, thin, platy structure; hard dry, friable moist, slightly sticky and slightly plastic wet; few roots, common fine pores; few light-gray lime spots; strong effervescence; moderately alkaline; clear, wavy boundary.

C3—17 to 60 inches, pale-yellow (5Y 7/3) silty shale and siltstone, olive (5Y 5/3) moist; some plates stained with light yellowish brown (2.5Y 6/4); medium and thick, platy structure; very hard dry, firm moist, very few fine roots along cracks in upper 6 inches; moderately alkaline; strong effervescence.

Depth to sedimentary beds ranges from 10 to 20 inches. The A horizon is grayish-brown or light brownish-gray loam, silt loam, or clay loam. It is mildly alkaline or moderately alkaline and is 2 to 6 inches thick. In places a transitional layer is between the A and C horizons. In places the A horizon is underlain by partly weathered material. The sedimentary beds in the C horizon are soft shale, siltstone, and very fine grained sandstone. This horizon has many layers that differ in color and texture. These layers contain brown and reddish-bown mottles that are caused by iron and manganese.

Cabba soils are associated with Amor, Chama, Reeder, and Wayden soils. They have a thinner solum than Amor, Chama, and Reeder soils, and they contain less clay than Wayden soils.

Cabba complex, sloping (CaC).—The soils in this complex are on long narrow ridges and knolls on uplands. Slopes are mainly 6 to 9 percent but range from 3 to 9 percent. This complex is about 60 percent Cabba loam and silt loam; 25 percent Amor, Chama, Morton, and Reeder loam and silt loam; and 15 percent other soils. Cabba soils are in the higher convex positions on the landscape, and Morton and Reeder soils are in the lower positions.

The Cabba soils have a profile similar to that described as representative of the Cabba series, but they have a thicker surface layer and subsoil and the surface layer is loam in places. Cultivation has exposed the lighter colored underlying layer in places.

Included with these soils in mapping are small areas of Wayden silty clay loam, Flasher fine sandy loam, Regent silty clay loam, and Moreau silty clay.

Runoff is medium to rapid, and the hazard of erosion is moderate.

Much of the acreage of these soils is cultivated along with larger areas of associated deeper soils. Susceptibility to erosion, low available water capacity in places, and loss of organic matter are concerns if these soils are cultivated. Management practices that help to control erosion and to maintain organic-matter content, tilth, and fertility are needed. These soils are suited to cultivation if good management practices are used. They also are suited to grasses. Capability unit IVe–4L; Shallow range site; windbreak suitability group 8.

Cabba complex, steep (CaE).—The soils in this complex are on uplands that are dissected by small drainageways. Slopes range from 9 to 40 percent but are mainly greater than 20 percent. This complex is about 65 percent Cabba loam and silt loam; 25 percent Amor, Chama, Morton, and Reeder loams and silt loams; and 10 percent other soils. Cabba soils are in the higher positions on the landscape, and Amor, Chama, Morton, and Reeder soils are in the lower concave positions.

The Cabba soils have the profile described as representative of the series.

Included with these soils in mapping are small areas of Wayden silty clay loam, Flasher fine sandy loam, Regent silty clay loam, Moreau silty clay, and Rhoades loam. Where slopes are broken, outcrops of baked shale (porcellanite), sandstone, and shale occur as small knobs or bands, 5 to 50 feet wide, on the crest of slopes. Also included along stream valleys are areas of Cabba soils mixed with gravelly material, some areas where a thin mantle of alluvium overlies shale, and areas of Cabba and Wayden stony soils that are 3 acres or less in size.

Runoff is rapid to very rapid, and the hazard of erosion is severe.

Most of the acreage of these soils is in grasses. In a few places these soils are cultivated, mainly in small tracts along with other soils that are better suited to cultivation. These soils are not suited to cultivation, because of shallowness and steepness. Water erosion is a concern if they are overgrazed or tilled. Management practices that maintain a good grass cover and fertility are needed. Capability unit VIe–Sw; Shallow range site; windbreak suitability group 10.

Cabba-Amor loams, sloping (CbC).—The soils in this complex are on uplands. Slopes are mainly 6 to 9 percent but range from 3 to 9 percent. This complex is about 45 percent Cabba loam, silt loam, and clay loam; 35 percent Amor loam and silt loam; and 20 percent other soils. Cabba soils have a thinner surface layer and subsoil than Amor soils. Cabba soils are in the higher convex positions on the landscape. Chama soils are in the higher middle positions, and Amor soils are in concave areas in the lower middle positions.

The profile of the Cabba soils is similar to that described as representative of the Cabba series, but the surface layer and the subsoil are thicker and the surface layer is silt loam and clay loam in places. In places cultivation has exposed the lighter colored underlying layer.

The profile of the Amor soils is similar to that described as representative of the Amor series, except that in places the surface layer is silt loam.

Included with these soils in mapping are small areas of Reeder loam, Flasher fine sandy loam, and Rhoades loam.

Runoff is medium, and the hazard of erosion is moderate.

Much of the acreage of these soils is cultivated. The soils are suited to cultivation if good management practices are used. Control of erosion is a necessary part of good management. These soils are suited to grass. Both soils in capability unit IVe–4L; Cabba part in Shallow range site; windbreak suitability group 8; Amor part in Silty range site; windbreak suitability group 3.

Cabba-Amor loams, hilly (CbD).—The soils in this complex are on uplands. Slopes range from 9 to 15 percent. This complex is about 45 percent Cabba loam and silt loam; 35 percent Amor loam and silt loam; and 20 percent other soils. Cabba soils have a thinner surface layer and subsoil than Amor soils. They are in the higher convex positions on the landscape, and Amor soils are in concave areas near the lower middle positions. In places these soils are on some of the ridges and knolls and are capped with a thin layer of gravel.

The profile of the Cabba soils is similar to that described as representative of the Cabba series, but the surface layer and subsoil are thicker and the surface layer is silt loam in places.

The profile of the Amor soils is similar to that described as representative of the Amor series, but in places the surface layer is silt loam or loam.

Included with these soils in mapping are small areas of Chama loam and silt loam, Reeder loam, Flasher fine sandy loam, and Rhoades loam.

Runoff is rapid, and the hazard of erosion is severe.

Most of the acreage of these soils is in grass. In a few places the soils are cultivated, mainly in small tracts along with other soils that are well suited to cultivation. These soils are not suited to cultivation, because of shallowness and steepness.

Controlling water erosion is a need if these soils are overgrazed or tilled. Management practices that maintain a good grass cover and fertility are needed. Both soils in capability unit VIe–Sw; Cabba part in Shallow range site; windbreak suitability group 10; Amor part in Silty range site; windbreak suitability group 3.

Cabba-Wayden-Shale outcrop complex (Cd).—The soils in this complex are on uplands, and slopes are dominantly steep but range from 3 to 50 percent. Most slopes

are more than 20 percent. This complex is about 50 percent Cabba loam, silt loam, and clay loam; 20 percent Wayden silty clay loam and silty clay; 15 percent outcrops; and 15 percent other soils. The outcrops are silty shale and sandstone. In places on the ridges and knolls, these soils are capped with a thin layer of gravel. About 10 to 30 percent of the acreage is barren. A few cedar, ash, boxelder, and shrubs are in many of the steep ravines.

The profile of the Cabba soils is similar to that described as representative of the Cabba series, but the surface layer is thinner and in places is loam or clay loam.

The profile of the Wayden soils is similar to that described as representative of the Wayden series, but the surface layer is thinner and in places is silty clay loam.

Included with these soils in mapping are areas, 10 acres or less in size, of gently sloping to steep Flasher soils and gently sloping to strongly sloping Amor, Moreau, Morton, Reeder, Regent, and Rhoades soils. The Amor, Moreau, Morton, Reeder, and Regent soils are in the lower positions. Also included are small areas of Cherry, Patent, and Vebar soils.

Runoff is medium on the less sloping soils in this unit and very rapid on the steep soils. The hazard of erosion is severe on soils that are steep.

These soils are used for grazing. They are not suited to cultivation. Some areas are not accessible for grazing, because of steepness and roughness of the terrain. Some of these areas are used as habitat for deer, antelope, and upland birds.

Water erosion is a concern if these soils are overgrazed. Management practices that maintain a good grass cover and fertility are needed. All soils in capability unit VIIe–Sw; Cabba and Wayden parts in Shallow range site; windbreak suitability group 10; Shale outcrop part; range site not assigned; windbreak suitability group 10.

Cabba and Wayden stony soils (Ce).—The soils in this unit are on uplands. They are gently sloping to steep, but they are dominantly strongly sloping. The surface soil contains 25 to 75 percent stones of chert, flint, and sandstone, mostly 5 to 48 inches in length. Some areas are part Cabba loam and silt loam and part Wayden silty clay loam, and others are entirely Cabba soils or entirely Wayden soils. South and west of Rhame, Cabbart soils occur in this complex in place of Cabba soils and Yawdim soils occur in place of Wayden soils.

The profile of the Cabba soils is similar to that described as representative of the Cabba series, but the surface layer is thicker and in places is loam.

The profile of the Wayden soils is similar to that described as representative of the Wayden series, but the surface layer is thicker and is silty clay loam.

Included with these soils in mapping are small areas of Flasher fine sandy loam and Wabek loam.

Runoff is medium on the less sloping soils in this unit and rapid on the steep soils. It is less than on Cabba and Wayden soils that are not stony.

All areas of these soils are in native grasses, and they are used for grazing. Some areas have potential for use as wildlife habitat. Rock is quarried in places for use in dam and road construction. Management practices that maintain fertility, organic-matter content, and plant cover are needed. Both soils in capability unit VIIe–Sw; Shallow range site; windbreak suitability group 10.

Cabbart Series

This series consists of shallow, well-drained, sloping to very steep soils on uplands. These soils formed in weathered soft shale, siltstone, and fine-grain sandstone.

In a representative profile the surface layer is light brownish-gray silt loam about 4 inches thick. Below this is a friable, light yellowish-brown, silt loam transitional layer about 3 inches thick. The underlying material is pale-yellow silt loam about 7 inches thick over pale-yellow, pale-olive, olive-gray, and light yellowish-brown soft shale and siltstone.

Permeability is moderate. Available water capacity, organic-matter content, and fertility are low. Tilth is poor.

Most areas of these soils are in native grasses, including green needlegrass, western wheatgrass, blue grama, needle-and-thread, and little bluestem. Areas that have slopes of less than 9 percent are cultivated along with larger areas of associated Boxwell and Marmarth soils. These Cabbart soils are better suited to grasses than to other crops. Most areas have slopes of more than 9 percent and are too steep to be used for cultivated crops.

Representative profile of a Cabbart silt loam in an area of Cabbart complex, steep, in native grass, 110 feet west and 240 feet north of the southeast corner of sec. 15, T. 129 N., R. 104 W.:

A1—0 to 4 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, subangular blocky structure parting to fine, subangular blocky and crumb structure; soft dry, friable moist, sticky and slightly plastic wet; slight effervescence; mildly alkaline; clear, smooth boundary.

AC—4 to 7 inches, light yellowish-brown (2.5Y 6/3) silt loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, subangular blocky structure; hard dry, friable moist, sticky and slightly plastic wet; violent effervescence; moderately alkaline; clear, smooth boundary.

C1ca—7 to 14 inches, pale-yellow (2.5Y 7/3) silt loam, light olive brown (2.5Y 5/3) moist; partly weathered shale; slightly hard dry, friable moist, sticky and slightly plastic wet; violent effervescence; many lime nodules; moderately alkaline; gradual, wavy boundarly.

C2—14 to 20 inches, light yellowish-brown (2.5Y 6/3) siltstone, light olive brown (2.5Y 5/3) moist; dark yellowish-brown (10YR 4/4) iron concretions, yellowish brown (10YR 5/4) dry; weak platy structure; slightly hard dry; friable moist, slightly sticky and slightly plastic wet; strong effervescence; moderately alkaline; gradual, wavy boundary.

C3—20 to 51 inches, olive-gray and pale-olive (5Y 5/2 and 6/3) platy siltstone, olive gray and olive (5Y 4/2 and 5/3) moist; dark yellowish brown and yellowish brown (10YR 4/4 and 5/6) moist stains on horizontal faces of plates; hard dry, friable moist, sticky and slightly plastic wet; slight effervescence; mildly alkaline; gradual, wavy boundary.

C4—51 to 60 inches, pale-olive and pale-yellow (5Y 6/3 and 7/3) soft shale, olive and pale olive (5Y 5/3 and 6/3) moist; slightly hard dry, very friable moist, slightly sticky and slightly plastic wet; slight effervescence; mildly alkaline.

Depth to sedimentary beds ranges from 10 to 20 inches. The A horizon is light brownish-gray or grayish-brown loam, silt loam, or clay loam. It is mildly alkaline to moderately alkaline and is 2 to 6 inches thick. The A horizon is underlain by partly weathered shale in places. The sedimentary beds in the C horizon are soft shale, siltstone, and very fine grain sandstone. This horizon has many layers that differ in color and texture. Brown and reddish-brown mottles, caused by

iron and manganese, are in some parts of the C horizon.

Cabbart soils are associated with Boxwell, Marmarth, and Yawdim soils. Cabbart soils have a thinner solum than Boxwell and Marmarth soils. They are finer textured than Yawdim soils.

Cabbart-Boxwell loams, sloping (CgC).—The soils in this complex are on uplands. Slopes are mainly 6 to 9 percent but range from 3 to 9 percent. The complex is 45 percent Cabbart loam, silt loam, and clay loam; 35 percent Boxwell loam and silt loam; and 20 percent included soils. Cabbart soils have a thinner surface layer and subsoil than Boxwell soils. Cabbart soils are in higher convex positions on the landscape, and Boxwell soils are near the center and lower positions.

The profile of Cabbart soils is similar to the one described as representative of the Cabbart series, but the surface layer and the subsoil are thicker and the texture of the surface layer generally is loam but is clay loam in places. Cultivation has exposed the lighter colored underlying layer in places.

The profile of Boxwell soils is similar to the one described as representative of the Boxwell series, but the surface layer is silt loam in places.

Included with these soils in mapping are small areas of Marmarth loam, Fleak fine sandy loam, and Absher and Rhoades loams.

Runoff is medium. The hazard of erosion is moderate.

Much of the acreage of these soils is cultivated. The soils are suited to cultivation if good management practices are used. Control of erosion is a necessary part of good management. The soils in this complex are suited to grasses. Both soils in capability unit IVe–4L; Cabbart part in Shallow range site; windbreak suitability group 8; Boxwell part in Silty range site; windbreak suitability group 3.

Cabbart-Boxwell loams, hilly (CgD).—The soils in this complex are on uplands. Slopes are 9 to 15 percent. The complex is about 50 percent Cabbart loam and silt loam, 30 percent Boxwell loam and silt loam, and 20 percent included soils. Cabbart soils have a thinner surface layer and subsoil than Boxwell soils. Cabbart soils are in the higher convex positions on the landscape, and Boxwell soils are near the center and lower positions.

The profile of Cabbart soils is similar to the one described as representative of the Cabbart series, but the surface layer and subsoil are thicker and the texture of the surface layer is loam.

The profile of Boxwell soils is similar to the one described as representative of the Boxwell series, but the surface layer is silt loam in places.

Included with these soils in mapping are small areas of Marmarth, Absher, and Rhoades loams. In places some of the soils on ridges and knolls are capped by a thin layer of gravel.

Runoff is rapid. The hazard of erosion is severe.

Nearly all of the acreage of these soils is in grasses. In a few places the soils are cultivated, mainly in small tracts along with other soils that are better suited to cultivation. Shallowness and steepness make these soils unsuitable for cultivation. Water erosion is a hazard if the soils are overgrazed or tilled. Management practices that maintain a good grass cover and fertility are needed. Both soils in capability unit VIe–Sw; Cabbart part in Shallow range site; windbreak suitability group 10; Boxwell part in Silty range site; windbreak suitability group 3.

Cabbart complex, steep (ChE).—The soils in this complex are rolling to steep but are mainly steep. Slopes range from 9 to 40 percent. They are on uplands that are dissected by small drainageways. About 65 percent of the complex is Cabbart loam and silt loam, 25 percent is Boxwell or Marmarth loams and silt loams, and 10 percent is included soils. Cabbart soils are in the higher positions on the landscape.

Cabbart soils have a profile similar to the one described as representative of the series, but in some places the surface layer is loam.

Included with these soils in mapping are small areas of Yawdim silty clay loam, Fleak fine sandy loam, Regent silty clay loam, Moreau silty clay, and Rhoades and Absher loams. Where slopes are broken, outcrops of baked shale (porcellanite), sandstone, and shale occur as small knobs or bands, 5 to 50 feet wide, on the crest of slopes. Along stream valleys this complex has inclusions of gravelly land. In some places a thin mantle of alluvium is over shale.

Runoff is rapid to very rapid. The hazard of erosion is severe.

Most of the acreage of the soils in this complex is in grasses. In a few places the soils are cultivated, mainly in small tracts along with other soils that are better suited to cultivation. Shallowness and steepness of slopes make this unit unsuitable for cultivation. Water erosion is a hazard if the soils are overgrazed or tilled. Management practices that maintain a good grass cover and fertility are needed. Capability unit VIe–Sw; Shallow range site; windbreak suitability group 10.

Cabbart-Yawdim-Shale outcrop complex (Ck).—In this complex are gently sloping to very steep soils on uplands. Slopes range from 3 to 50 percent. Slopes are mainly smooth and steep and generally are more than 20 percent. About 50 percent of this complex is Cabbart loam, silt loam, and clay loam; 20 percent is Yawdim silty clay loam and silty clay; 15 percent is shale outcrop; and 15 percent is included soils. Outcrops are mainly on ridge crests at the edge of valleys crossed by deeply cut streams. The outcrops are silty shale and sandstone. In places some of the soils on ridges and knolls are capped with a thin layer of gravel. From 10 to 30 percent of the area is bare. In many of the steep ravines are a few cedar, ash, boxelder, or shrubs.

The profile of the Cabbart soils is similar to the one described as representative of the Cabbart series, but the surface layer is thinner and in places is loam or clay loam.

The profile of the Yawdim soils is similar to the one described as representative of the Yawdim series, but the surface layer is thinner and in places is silty clay loam.

Included in mapping are areas, 10 acres or less in size, of gently sloping to steep Fleak and Tusler soils and gently sloping to strongly sloping Rhoades, Absher, Daglum, Marmarth, Moreau, and Boxwell soils. Also included are small areas of Cherry and Patent soils.

Runoff is medium in gently sloping areas and very rapid in steep areas. The hazard of erosion is severe in steep and very steep areas.

This complex is used for grazing. It is not suited to cultivation. The steep slopes and rough terrain are not easily accessible for grazing. In most places deep ravines or gulches provide protection for grazing animals from blizzards in winter. These areas provide habitat for deer, antelope, and upland game birds. Water erosion is a hazard if the soils are overgrazed. Management practices that maintain good grass cover and fertility are needed. All soils in capability unit VIIe–Sw; windbreak suitability group 10. Cabbart and Yawdim parts in Shallow range site. Shale outcrop not assigned a range site.

Chama Series

This series consists of moderately deep, well-drained, nearly level to sloping soils on uplands. These soils formed in material weathered from shale, siltstone, and fine-grain sandstone.

In a representative profile the surface layer is dark grayish-brown silty clay loam about 6 inches thick. The subsoil is friable, grayish-brown silty clay loam about 7 inches thick. It is strongly effervescent in the lower part. The underlying material is calcareous, light-gray silty clay loam about 21 inches thick over soft, silty, shale sedimentary beds.

Permeability, available water capacity, and organic-matter content are moderate. Fertility is medium. Tilth is fair.

These soils are used for crops. Some areas are in native grasses. Green needlegrass, needle-and-thread, western wheatgrass, and blue grama are the main species. These soils are suited to cultivated crops.

Representative profile of a Chama silty clay loam in an area of Chama and Morton silty clay loams, gently sloping, in a cultivated field, 90 feet west and 180 feet north of the southeast corner of sec. 11, T. 132 N., R. 99 W.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, granular stucture; slightly hard dry, friable moist, sticky and plastic wet; neutral; abrupt, smooth boundary.

B2—6 to 9 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; peds coated with very dark grayish brown (10YR 3/2) moist; weak, medium, prismatic structure parting to moderate, medium, angular blocky structure; hard dry, friable moist, sticky and plastic wet; mildly alkaline; clear, wavy boundary.

B3Ca—9 to 13 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure parting to weak, medium, angular blocky structure; hard dry, friable moist, sticky and plastic wet; strong effervescence; few segregations of nodular lime; moderately alkaline; gradual, wavy boundary.

C1ca—13 to 25 inches, light-gray (5Y 7/2) silty clay loam, olive gray (5Y 5/2) moist; weak, medium, angular blocky structure; very hard dry, friable moist, sticky and plastic wet; violent effervescence; many segregations of nodular lime; moderately alkaline; gradual, wavy boundary.

C2—25 to 34 inches, light-gray (5Y 7/2) silty clay loam, olive gray (5Y 5/2) moist; few, faint mottles of light olive brown (2.5Y 5/6) moist; weak, medium, subangular blocky structure; very hard dry, firm moist, sticky and plastic wet; strong effervescence; few segregations of lime; moderately alkaline; gradual, wavy boundary.

C3—34 to 60 inches, light-gray and light olive-gray (5Y 7/2 and 5/2) soft silty shale beds, weathered in the upper part, olive gray (5Y 5/2) moist; few, faint mottles of light olive brown (2.5 5/6) moist; very hard dry, firm moist, very sticky and very plastic wet; violent effervescence; moderately alkaline.

The solum ranges from 12 to 26 inches in thickness. Depth to carbonates ranges from 0 to 10 inches. Depth to sedimentary beds in most places is 30 to 40 inches, but it ranges from 20 to 40 inches. The A horizon is grayish-brown, dark grayish-brown, and brown loam, silt loam, clay loam, and silty clay loam. It ranges from 4 to 8 inches in thickness and is neutral to moderately alkaline. The B horizon is loam, silt loam, clay loam, and silty clay loam. The B horizon is weak or moderate in structure. The sedimentary beds in the C horizon are shale and siltstone.

Chama soils are associated with Cabba and Morton soils. Chama soils have thicker A and B horizons than Cabba soils. They have a less pronounced structure than Morton soils.

Chama and Morton silty clay loams, nearly level (CmA).—The soils in this mapping unit are on uplands. Some areas are all Chama silty clay loam or all Morton silty clay loam. Other areas consists of both the Chama soil and the Morton soil.

The profile of the Chama soil is similar to that described as representative of the Chama series, but the surface layer and the subsoil are thicker.

The profile of the Morton soil is similar to that described as representative of the Morton series, but the surface layer is thicker.

Included with these soils in mapping are small areas of Regent and Rhoades silty clay loams.

Runoff is medium. The hazard of erosion is slight.

Nearly all areas of these soils are cultivated. The soils are well suited to cultivated crops. The main needs of management are conserving moisture and maintaining fertility. Both soils in capability unit IIc–6; Silty range site. Chama part in windbreak suitability group 8; Morton part in windbreak suitability group 3.

Chama and Morton silty clay loams, gently sloping (CmB).—The soils in this mapping unit are on uplands. Slopes are 3 to 6 percent. Some areas are all Chama silty clay loam or all Morton silty clay loam. Other areas consist of both the Chama soil and the Morton soil. The Chama soil has a thinner solum than the Morton soil.

The Chama soil has the profile described as representative of the Chama series.

The Morton soil has the profile described as representative of the Morton series.

Included with these soils in mapping are small areas of Regent silty clay loam and of Cabba, Rhoades, and Daglum silt loams. Also included are 217 acres of moderately eroded soils.

Runoff is medium. The hazard of erosion is slight to moderate. Erosion is not a major hazard, but controlling runoff is a necessary part of management.

Most of the acreage of these soils is cultivated. The soils are suited to cultivated crops commonly grown in the county. Both soils in capability unit IIe–6; Silty

range site. Chama part in windbreak suitability group 8; Morton part in windbreak suitability group 3.

Chama, Morton, and Cabba silty clay loams, sloping (CnC).—In this mapping unit are soils on uplands. These soils are mainly sloping, but slopes range from 6 to 12 percent. Some areas are all Chama silty clay loam, all Morton silty clay loam, or all Cabba silty clay loam. Other areas consist of the Chama soil, the Morton soil, or the Cabba soil or of a combination of two of these soils. Cabba soils have a thinner profile than Chama or Morton soils. Cultivation has exposed the light-colored substratum of the Cabba soils in a few places. Cabba soils are on the crests of knolls, hills, and ridges. Chama and Morton soils are near the middle and lower concave positions.

The profiles of Chama and Morton soils are similar to the ones described as representative of their respective series, but the surface layer and subsoil are thinner.

The profile of the Cabba soil is similar to the one described as representative of the Cabba series, but the surface layer is silty clay loam.

Included with these soils in mapping are small areas of Regent silty clay loam, Moreau silty clay, and Rhoades and Daglum silty clay loams. Also included are 433 acres of moderately eroded soils.

Controlling water erosion is a necessary part of good management. Runoff is medium on the sloping soils and rapid on the strongly sloping soils. The hazard of erosion is moderate where slopes are 6 to 9 percent and severe where slopes are 9 to 12 percent.

These soils are used mainly for cultivated crops. A few scattered areas remain in native grasses. The soils are suited to most locally grown crops and to grasses. All soils in capability unit IIIe–6; Chama and Morton parts in Silty range site; Chama and Cabba parts in windbreak suitability group 8. Cabba part in Shallow range site; Morton part in windbreak suitability group 3.

Chanta Series

This series consists of moderately deep, well-drained, nearly level to gently sloping soils on terraces and fans. These soils formed in medium-textured alluvium over gravelly and sandy alluvium.

In a representative profile the surface layer is grayish-brown loam about 6 inches thick. The friable subsoil is about 20 inches thick. The upper part is brown loam; the middle part is grayish-brown loam; and the lower part is grayish-brown sandy loam. The underlying material is grayish-brown gravel and sand to a depth of about 29 inches and light brownish-gray gravel and sand below that depth.

Permeability is moderate to a depth of about 26 inches and rapid and very rapid below. Available water capacity is low. Organic-matter content is moderate. Fertility is medium. Tilth is good.

These soils are used for crops. Some areas are in native grasses, and green needlegrass, western wheatgrass, and blue grama are the main species. The soils are suited to cultivated crops.

Representative profile of Chanta loam, nearly level, in native grass, 265 feet west and 50 feet south of northeast corner of NW¼ sec. 13, T. 132 N., R. 107 W.:

A1—0 to 6 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium and fine, subangular blocky and crumb structure; slightly hard dry, friable moist, slightly sticky wet; many roots and fine pores; neutral; clear, smooth boundary.

B21—6 to 14 inches, brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate, medium and fine, prismatic structure parting to moderate, medium and fine, angular blocky structure; hard dry, friable moist, slightly sticky wet; common roots; many pores; thin patches of very dark grayish-brown (10YR 3/2) most clay films on faces of prisms; few pebbles; neutral; clear, smooth boundary.

B22—14 to 22 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate, medium and fine, prismatic structure parting to moderate, medium and fine, subangular blocky structure; hard dry, friable moist; few roots; common fine pores; neutral; clear, wavy boundary.

B3—22 to 26 inches, grayish-brown (2.5Y 5/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky structure; hard dry, friable moist; few pebbles; mildly alkaline; clear, wavy boundary.

IIC1ca—26 to 29 inches, grayish-brown (2.5Y 5/2) sand and gravel, dark grayish brown (2.5Y 4/2) moist; very weak, blocky structure and single grain; violent effervescence; moderately alkaline; clear, wavy boundary.

11C2—29 to 60 inches, light brownish-gray (2.5Y 6/2) gravel and sand, grayish brown (2.5Y 5/2) moist; single grain; loose; bottom of gravel coated with lime; strong effervescence; moderately alkaline.

The solum ranges from 16 to 30 inches in thickness, which corresponds to the depth to carbonates. Depth to sand and gravel is generally 20 to 30 inches, but it ranges from 20 to 40 inches. The A horizon is loam, silt loam, and clay loam and is 2 to 8 inches thick. The B horizon is brown or grayish-brown loam, silt loam, or clay loam. The structure of the B2 horizon is moderate or strong. The C horizon generally is a mixture of sand and gravel, but in places there are stratified layers of loamy sand, gravelly loam, or coarse sandy loam. In some places the C horizon is not calcareous. The coarse material commonly is several feet thick.

Chanta soils are associated with Kremlin and Wabek soils. They have a distinct gravel and sand C horizon within a depth of 40 inches that is lacking in Kremlin soils. They are deeper over gravel and sand than Wabek soils.

Chanta loam, nearly level (CoA).—This soil is on terraces and fans. Many pebbles are on the surface in places. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Belfield, Rhoades, and Kremlin loams.

Runoff is slow to medium. Soil blowing is a moderate hazard.

Much of this soil is cultivated. Other areas remain in native grasses. Controlling soil blowing is a necessary part of good management. This soil is suited to cultivated crops if good management practices are used. A few scattered areas have been mined for gravel. Capability unit IIIs–5; Silty range site; windbreak suitability group 6.

Chanta loam, gently sloping (CoB).—This soil is on terraces and fans. Slopes range from 3 to 6 percent. About 85 percent is Chanta loam. In places many pebbles are on the surface. The profile of this soil is similar to the one described as representative of the series, but it has a thinner surface layer.

Included with this soil in mapping are small areas of Belfield, Kremlin, and Rhoades loams.

Runoff is medium. Soil blowing is a moderate hazard.

Some areas of this soil are cultivated. Other areas remain in native grasses. Controlling soil blowing is a necessary part of good management. This soil is suited to cultivated crops if good management practices are used. A few scattered areas have been mined for gravel. Capability unit IIIes–5; Silty range site; windbreak suitability group 6.

Cherry Series

This series consists of deep, well-drained, nearly level to sloping soils on long fans and slopes below steep and hilly land. The soils formed in sediment eroded from steeper areas.

In a representative profile the surface layer is light brownish-gray clay loam about 7 inches thick. The subsoil is friable silty clay loam about 14 inches thick. The upper part is light brownish gray, and the lower part is pale olive. The underlying material is pale-olive silty clay loam to a depth of about 26 inches, grayish-brown silty clay loam to a depth of about 40 inches, and light-gray silt loam to a depth of 60 inches. The profile is calcareous throughout.

Permeability is moderate. Available water capacity is high. Organic-matter content is moderate. Fertility is medium. Water erosion is a hazard. Tilth is fair, but there is considerable surface crusting after rains.

About half of the acreage of these soils is cultivated. The other half is in native grasses, and green needlegrass, western wheatgrass, and blue grama are the principal species. These soils are suited to cultivated crops and to grasses commonly grown in the county. They are suited to trees, but conservation of water is needed for satisfactory growth.

Representative profile of Cherry clay loam, gently sloping, in a cultivated field, 85 feet west and 890 feet north of the southeast corner of sec. 21, T. 132 N., R. 104 W.:

Ap—0 to 7 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; strong, medium and fine, granular structure; slightly hard dry, friable moist, sticky and plastic wet; slight effervescence; mildly alkaline; abrupt, smooth boundary.

B21—7 to 12 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky structure; hard dry, friable moist, sticky and plastic wet; strong effervescence; common segregations of fine threads of lime; moderately alkaline; clear, smooth boundary.

B22—12 to 16 inches, pale-olive (5Y 6/3) silty clay loam; olive (5Y 5/3) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky structure; hard dry, friable moist, sticky and plastic wet; stong effervescence; common segregations of fine threads of lime; moderately alkaline; clear, smooth boundary.

B3ca—16 to 21 inches, pale-olive (5Y 6/3) silty clay loam, olive (5Y 5/3) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky structure; hard dry, friable moist, sticky and plastic wet; violent effervescence; common segregations of lime; moderately alkaline; clear, wavy boundary.

C1ca—21 to 26 inches, pale-olive (5Y 6/3) silty clay loam, olive (5Y 5/3) moist; weak, medium, subangular blocky structure; hard dry, firm moist, sticky and plastic wet; violent effervescence; many segregations of lime; moderately alkaline; clear, wavy boundary.

C2ca—26 to 40 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard dry, friable moist, sticky and plastic wet; violent effervescence; many segregations of lime; moderately alkaline; clear, wavy boundary.

IIC3ca—40 to 60 inches, light-gray (5Y 7/2) silt loam, olive gray (5Y 5/2) moist; auger sample slightly hard, friable, slightly sticky and slightly plastic; violent effervescence; segregations of lime; moderately alkaline.

The solum ranges from 20 to 36 inches in thickness. Depth to carbonates ranges from 0 to 10 inches. The A horizon is light brownish-gray or grayish-brown silt loam, clay loam, or silty clay loam. It ranges from 3 to 8 inches in thickness and is mildly alkaline or moderately alkaline. The structure of the A horizon is weak or moderate. The B horizon is light brownish-gray, pale-olive, or grayish-brown clay loam or silty clay loam. The structure of the B horizon is weak or moderate. In some places the lower part of the C horizon is loam or silt loam. Textural stratification is common in the C horizon in places.

Cherry soils are associated with Patent and Savage soils. Cherry soils have a B horizon that is lacking in Patent soils. They are lighter colored than Savage soils.

Cherry clay loam, nearly level (CrA).—This soil is on fans scattered throughout the uplands. It receives runoff from adjacent slopes. The profile of this soil is similar to that described as representative of the series, but the surface layer and the subsoil are thicker.

Included with this soil in mapping are small areas of Patent clay loam, Savage silty clay loam, and Rhoades clay loam.

Runoff is medium, and the hazard of erosion is slight.

Much of this soil is cultivated. Some areas are in native grasses. The soil is suited to cultivated crops. Capability unit IIc–6; Silty range site; windbreak suitability group 3.

Cherry clay loam, gently sloping (CrB).—This soil is on fans (fig. 9) on uplands. Slopes are 3 to 6 percent. The soil receives runoff from adjacent areas. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Morton and Savage silty clay loams and Patent and Rhoades clay loams.

Runoff is medium, and the hazard of water erosion is moderate to severe. Controlling water erosion is a necessary part of good management.

About half of the acreage of this soil is cultivated. The other half remains in native grasses. This soil is suited to cultivated crops if intensive management practices are used. Capability unit IIIe–6; Silty range site; windbreak suitability group 3.

Cherry clay loam, sloping (CrC).—This soil is on fans and toe slopes below steep and hilly areas on uplands. Slopes range from 6 to 9 percent. The profile of this soil is similar to that described as representative of the series, but the surface layer and subsoil are thinner.

Included with this soil in mapping are small areas of Chama silty clay loam and Patent and Rhoades clay loams. Also included are a few areas of Cherry clay loam, strongly sloping.

Figure 9.—**An area of Cherry soils, gently sloping, on fans, Cabba and Wayden soils are in background.**

Runoff is medium, and the hazard of erosion is severe. Runoff from adjacent steep soils on uplands has caused rills and small gullies across some areas. Controlling erosion is a necessary part of good management.

Some areas of this soil are cultivated. Other areas are in grasses. This soil is suited to cultivated crops if good management practices are used. Moisture conservation is needed for satisfactory growth of trees. Capability unity IIIe–6; silty range site; windbreak suitability group 3.

Daglum Series

This series consists of deep, well-drained and moderately well drained, nearly level to gently sloping soils on terraces, fans, and uplands. These soils formed in alluvium. They have a claypan subsoil.

In a representative profile the surface layer is grayish-brown loam about 8 inches thick. The subsurface layer is light brownish-gray and light-gray loam about 2 inches thick. The subsoil is dark grayish-brown firm silty clay about 14 inches thick. Below the subsoil is grayish-brown silty clay about 15 inches thick. Beneath this is olive-gray clay loam. All layers below the upper part of the subsoil contain salt masses.

Permeability is slow. Available water capacity is moderate. Organic-matter content is moderate. Fertility is medium. The slowly permeable subsoil restricts root penetration. Most of the roots that penetrate the subsoil are between the columns. Salinity and alkalinity of the lower part of the subsoil and the underlying material limit the availability of moisture and plant nutrients.

These soils are used for pasture and crops. They are tilled where they occur with a few scattered areas of Rhoades and Absher soils or other soils that are better suited to crops. Where they occur with a high percentage of Rhoades and Absher soils, they are used for grazing. The native vegetation consists mainly of blue grama, needle-and-thread, western wheatgrass, and threadleaf sedge. These soils are not suited to trees.

Representative profile of a Daglum loam in an area of Daglum-Rhoades loams, nearly level, in a cultivated field, 1,320 feet north and 92 feet west of the southeast corner of NE¼ sec. 12, T. 130 N., R. 106 W.:

Ap—0 to 8 inches, grayish-brown (10YR 5/2) loam; very dark grayish brown (10YR 3/2) moist; moderate, fine and medium, crumb structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; slightly acid; abupt, smooth boundary.

A2—8 to 10 inches, light brownish-gray and light-gray (10YR 6/2 and 7/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, thin and medium, platy structure; slightly hard dry, very friable moist, slightly sticky and nonplastic wet; slightly acid; abrupt, smooth boundary.

B21t—10 to 12 inches, dark grayish-brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; very dark grayish-brown (10YR 3/2) coats on ped faces; strong, fine and medium, columnar structure breaking to moderate, fine and medium, angular blocky structure; very hard dry, firm moist, very sticky and very plastic wet; columns have light brownish-gray (10YR 6/2) cap about one-half inch thick; mildly acid; clear, smooth boundary.

B22t—12 to 16 inches, dark grayish-brown (2.5Y 4/2), moist, silty clay; very dark grayish-brown (10YR 3/2) coats on ped faces; moderate, fine and medium, prismatic structure parting to strong, fine and medium, angular blocky structure; very hard dry, firm moist, very sticky and very plastic wet; mildly alkaline; clear, smooth boundary.

B3ca—16 to 24 inches, dark grayish-brown (2.5Y 4/2), moist, silty clay; very dark grayish-brown (2.5Y 3/2) coats on the ped faces; moderate, fine and medium, angular blocky structure; very hard dry, firm moist, very sticky and very plastic wet; common crystalline salt masses (thread and nests); violent effervescence; moderately alkaline; clear, wavy boundary.

C1cs—24 to 31 inches, grayish-brown (2.5Y 5/2), moist, silty clay; dark grayish-brown (2.5Y 4/2) coats on ped faces; weak, medium, angular blocky structure; hard dry, firm, moist, very sticky and very plastic

wet; many crystalline salt masses (thread and nests) strong effervescence; strongly alkaline; gradual boundary.

C2cs—31 to 39 inches, grayish-brown (2.5Y 5/2), moist, silty clay; dark grayish-brown (2.5Y 4/2) coats on ped faces; weak, medium, angular blocky structure; hard dry, firm moist, very sticky and very plastic wet; common crystalline salt masses (nests); slight effervescence; strongly alkaline; clear, wavy boundary.

C3cs—39 to 44 inches, olive-gray (5Y 4/2), moist, clay loam; many, fine, faint, yellowish-brown (10YR 5/6) mottles; massive; hard dry, friable moist, sticky and very plastic wet; many crystalline salt masses (nests); slight effervescence; moderately alkaline.

The solum ranges from 15 to 32 inches in thickness. Depth to visible salts ranges from 10 to 18 inches. The combined thickness of the A horizon above the columns is more than 6 inches. The A horizon is dark grayish brown, grayish brown, light brownish gray, and light gray. It ranges from slightly acid to neutral and is fine sandy loam, loam, silt loam, clay loam, or silty clay loam. The A2 horizon is coarser textured than the A1 horizon in places. In places the A2 horizon is indicated only by a light-gray color on the rounded top of the columns. The B horizon is dark grayish-brown, grayish-brown, and brown clay loam, silty clay loam, and silty clay. It ranges from mildly alkaline to strongly alkaline. The structure of the B horizon is moderate or strong. The peds of the B horizon are coated very dark grayish brown when moist, and some sand grains coat the side of the columns in places. The substratum is loam, silt loam, clay loam, silty clay loam or silty clay and is mottled in some places. Sedimentary beds of shale or siltstone occur below a depth of 40 inches in many places.

Daglum soils are associated with Belfield, Ekalaka, Ladner, and Rhoades soils. They are deeper over salts and have a thicker A horizon than Rhoades and Ladner soils. They have a denser B horizon than Belfield soils. They have a finer textured B horizon than Ekalaka soils.

Daglum fine sandy loam, gently sloping (DaB).—This soil is on terraces, fans, and uplands. Slopes are mainly 3 to 6 percent but range from 0 to 6 percent. A pitted microrelief occurs where these soils are associated with Rhoades soils. Daglum fine sandy loam formed in material of which the upper part is fine sandy loam and the lower part is finer textured alkaline material. The profile of this soil is similar to that described as representative of the series, but the surface layer is fine sandy loam.

Included with this soil is mapping are small areas of Ekalaka fine sandy loam, Rhoades loam, and Rhoades fine sandy loam. Also included are areas where Daglum soils are underlain by sedimentary beds at a depth of less than 40 inches.

Runoff is slow in gently sloping areas and medium in more sloping areas. Soil blowing is a hazard. Controlling soil blowing is a necessary part of good management.

Much of this soil is cultivated, but a few areas remain in grasses. This soil is suited to cultivated crops if good management practices are used. Where this soil is cultivated along with Rhoades soils in dispersed areas, corn emerges and develops slowly. This soil is better suited to grasses than to other uses. Capability unit IVe–3P; Claypan range site; windbreak suitability group 9.

Daglum-Rhoades loams, nearly level (DdA).—The soils in this complex are on high terraces. About 60 percent of the complex is Daglum loam, 20 percent Rhoades loam, and 20 percent included soils. The Daglum soil has a thicker surface layer above the claypan subsoil than the Rhoades soil. There is a pitted microrelief where Rhoades soils occur.

The Daglum soil has the profile described as representative of the Daglum series.

The profile of the Rhoades soil is similar to the one described as representative of the Rhoades series.

Included with these soils in mapping are small areas of Belfield and Kremlin loams. Also included are areas where the Daglum soils are underlain by sedimentary beds at a depth of less than 40 inches.

Runoff is slow and medium, and the hazard of erosion is slight. Saline and alkaline conditions below the upper part of the subsoil limit the availability of moisture. Conserving moisture is a necessary part of good management.

Most areas of these soils are used for cultivated crops. A few areas remain in native grasses. These soils are suited to cultivated crops if moisture conservation practices are used. They are well suited to grasses and to grazing. Both parts in capability unit IVs–P; Daglum part in Claypan range site; windbreak suitability group 9; Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Desart Series

This series consists of deep, well-drained, gently undulating soils on fans, terraces, and uplands. These soils have a claypan subsoil. They formed in alluvium and in material weathered from sandstone.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 23 inches thick. The subsurface layer is loamy fine sand about 6 inches thick. The upper part is grayish brown, and the lower part is light brownish gray. The subsoil is firm, grayish-brown and light olive-brown fine sandy loam 11 inches thick. The underlying material is strongly alkaline, light brownish-gray and light yellowish-brown fine sandy loam about 10 inches thick over olive-brown soft sandstone sedimentary beds.

Permeability is moderately rapid above the claypan subsoil and slow in the subsoil and the substratum. Available water capacity and organic-matter content are moderate. Fertility is medium. Soil blowing is a hazard.

These soils are used for pasture and crops. Native vegetation consists of blue grama, needle-and-thread, green needlegrass, and upland sedges. These soils are suited to cultivated crops and grasses common to the county.

Representative profile of Desart fine sandy loam in an area of Ekalaka-Desart fine sandy loams, gently undulating, in a cultivated field, 155 feet west and 740 feet south of the northeast corner of SE¼ sec. 10, T. 130 N., R. 103 W.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; very weak, coarse, subangular blocky structure parting to weak, coarse, crumb structure; slightly hard dry, very friable moist, nonsticky and nonplastic wet; neutral; abrupt, smooth boundary.

A1—7 to 23 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, very coarse, subangular blocky structure; slightly hard dry, very friable moist, nonsticky and nonplastic wet; neutral; clear, smooth boundary.

A21—23 to 25 inches, grayish-brown (10 YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak,

coarse and medium, subangular blocky structure; very friable moist, nonsticky and nonplastic wet; mildly alkaline; clear, smooth boundary.

A22—25 to 29 inches, light brownish-gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak, coarse and medium, subangular blocky structure parting to weak, thick, platy structure; very friable moist, nonsticky and nonplastic wet; moderately alkaline; abrupt, wavy boundary.

B21t—29 to 34 inches, grayish-brown and light olive-brown (2.5Y 5/3) fine sandy loam, dark grayish brown and olive brown (2.5Y 4/3) moist; peds stained very dark grayish brown (10YR 3/2) moist and coated with sand grains; strong, very coarse, columns parting to weak, medium, angular blocky structure; extremely hard dry, firm moist, sticky and plastic wet; moderately alkaline; gradual, wavy boundary.

B22t—34 to 40 inches, grayish-brown and light olive-brown 2.5Y 4/3) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; strong, coarse and medium, prismatic structure parting to strong, medium, angular blocky structure; extremely hard dry, firm moist, very sticky and very plastic wet; strongly alkaline; gradual, wavy boundary.

C1csca—40 to 50 inches, light brownish-gray and light yellowish-brown (2.5Y 6/3) fine sandy loam, grayish brown and light olive brown (2.5Y 5/3) moist; weak, medium, angular blocky structure; very hard dry, friable moist, sticky and plastic wet; many segregations of salts and lime; strong effervescence; strongly alkaline; clear, smooth boundary.

C2—50 to 60 inches, olive-brown (2.5Y 4/4) moist, strata of soft sedimentary sandstone beds, weathered in the upper part; slightly sticky and nonplastic wet; common segregations of salts and lime; strong effervescence; moderately alkaline.

The solum ranges from 30 to 55 inches in thickness. Depth to carbonates ranges from 28 to 44 inches. Depth to sedimentary beds in most places is 44 to 54 inches, but it ranges from 40 to 60 inches. The A1 horizon is dark grayish-bown or grayish-brown sandy loam, fine sandy loam, or loamy fine sand. It ranges from medium acid to neutral in reaction and from 15 to 28 inches in thickness. The A2 horizon ranges from less than ½ inch to 8 inches in thickness. It is of the same texture as the A1 horizon in places. The B horizon is olive-gray, grayish-brown, and light olive-brown sandy loam or fine sandy loam. It ranges from mildly alkaline to strongly alkaline. The sedimentary beds in the C horizon are sandy shale and soft sandstone. In places the material in the C horizon is mottled.

Desart soils are associated with Ekalaka, Rhame, Tally, and Vebar soils. They have a claypan at a greater depth than Ekalaka soils. They have a claypan in the B horizon that is lacking in Rhame, Tally, and Vebar soils.

Dilts Series

This series consists of shallow, well-drained, rolling to steep soils on uplands. These soils formed in material weathered from clayey shale and claystone.

In a representative profile the surface layer is olive-gray clay about 5 inches thick. Below this layer is gray clay about 14 inches thick. The underlying material is very strongly acid sedimentary beds of shale.

Permeability is slow. Available water capacity, organic-matter content, and fertility are low.

All of the acreage of these soils is used for wildlife or grazing. Rocky Mountain juniper and a few pine grow on some of these soils. These soils are not suited to cultivation. A large part of the areas is bare. Native vegetation includes various sages, rabbit brush, spike wheatgrass, western wheatgrass, false lupine, and annual weeds.

Representative profile of Dilts clay in an area of Dilts and Lisam Clays, rolling, in native grass, 1,455 feet east and 1,420 feet north of the southwest corner of NW¼ sec. 20, T. 130 N., R. 106 W.:

A1—0 to 5 inches, olive-gray (5Y 5/2) clay, olive gray (5Y 4/2) moist; weak, medium, subangular blocky and moderate, fine, granular structure; very hard dry, firm moist, sticky and very plastic wet; common fine roots; few small shale chips; medium acid; clear, wavy boundary.

C1—5 to 19 inches, gray (5Y 6/1) clay, dark gray (5Y 4/1) moist; weak, coarse, subangular blocky structure parting to moderate, medium and thin, platy structure; extremely hard dry, very firm moist, sticky and very plastic wet; few roots; 25 to 75 percent partly weathered shale; strongly acid; gradual boundary.

C2—19 to 40 inches, gray (5Y 6/1) sedimentary beds of shale; common yellow stains on surfaces of platy shale fragments; very strongly acid.

Depth to sedimentary beds ranges from 10 to 20 inches, but partly weathered beds are at a depth of 4 to 10 inches in places. The A horizon is dark grayish-brown, dark-gray, and olive-brown silty clay or clay. It is medium acid to slightly acid. The sedimentary beds in the C horizon are shale that has a crushed texture of silty clay and clay. Reddish and yellowish-brown stains are on plates of shale in places.

Dilts soils are associated with Lisam soils. They are acid, but Lisam soils are alkaline. They have more clay throughout than Yawdim soils, and the A and B horizons are denser.

Dilts and Lisam clays, rolling (D1C).—The soils in this mapping unit are on uplands. These soils generally are on low, rounded hills, in smooth-sided valleys, and in many drainageways. Slopes are mainly 6 to 9 percent but range from 3 to 9 percent. Some areas are part Dilts clay and silty clay and part Lisam clay and silty clay. Other areas are all Dilts soils or all Lisam soils. Vegetation is sparse. Some Rocky Mountain juniper and a few pines are in some places.

Dilts soils have a profile similar to the one described as representative of the Dilts series, but in places the surface layer is silty clay.

Lisam soils have a profile similar to the one described as representative of the Lisam series, but in places the surface layer is silty clay.

Included with these soils in mapping are small areas of Rhoades and Absher silty clay loams, Alluvial land, saline, and shale outcrop.

Runoff is medium to rapid. The main needs of management are controlling erosion and maintaining organic-matter content and fertility.

These soils are used only for grazing. They are better suited to grazing that to most other uses. Some areas have potential for wildlife habitat. Controlled grazing is a practice that helps to control erosion and to maintain the organic-matter content and fertility. Both soils in capabiliy unit VIs–SwC; Shallow Clay range site; windbreak suitability group 10.

Dilts and Lisam clays, steep (D1E).—The soils in this mapping unit are on uplands. Slopes range from 3 to 20 percent. These soils generally are on low, rounded hills, in smooth-sided valleys, and in many drainageways. Some areas are part Dilts clay and silty clay and part Lisam clay and silty clay. Other areas are all Dilts soils or all Lisam soils. Vegetation is very sparse.

The profile of Dilts soils is similar to the one described as representative of the Dilts series, but it is shallower

to sedimentary beds and in places the surface layer is silty clay.

The profile of Lisam soils is similar to the one described as representative of the Lisam series, but it is shallower to sedimentary beds and in places the surface layer is silty clay.

Included with these soils in mapping are small areas of Rhoades and Absher silty clay loams, Alluvial land, saline, and shale outcrop.

Runoff is rapid to very rapid. The main needs of management are controlling erosion and maintaining organic-matter content and fertility.

These soils are used only for grazing. They are better suited to grazing than to most other uses. Controlled grazing is a practice that helps to control erosion and to maintain the organic-matter content and fertility. Capability unit VIIs–SwC; Shallow Clay range site; windbreak suitability group 10.

Ekalaka Series

This series consists of deep, well-drained, gently sloping or gently undulating to rolling soils on terraces, fans, and uplands. These soils formed in alluvium and in material weathered from sandstone. They have a claypan subsoil.

In a representative profile the surface layer is fine sandy loam about 10 inches thick. It is dark grayish brown in the upper part and grayish brown below. The subsurface layer is light brownish-gray loamy fine sand about 2 inches thick. The light olive-brown subsoil is about 16 inches thick. The upper and middle parts are fine sandy loam. The lower part is loamy fine sand and contains salt crystals. The subsoil is extremely hard when dry. The underlying material is olive-gray loamy fine sand to a depth of about 38 inches and light olive-gray, stratified fine sandy loam and loamy fine sand that extends to a depth of 60 inches.

Permeability is rapid and moderately rapid above the claypan subsoil and slow in the subsoil. Organic-matter content is moderate. Available water capacity is moderate to low. Fertility is medium. The slowly permeable subsoil restricts root penetration. Most of the roots that penetrate the subsoil are between the columns. Soil blowing is a moderate to severe hazard.

The areas of Ekalaka soils are used for pasture and cultivated crops. Ekalaka fine sandy loam is cultivated, but Ekalaka loamy fine sand is used mainly for grazing. Ekalaka fine sandy loam is better suited to cultivated crops than Ekalaka loamy fine sand. These soils are not suited to trees. The native vegetation consists mainly of blue grama, needle-and-thread, upland sedges, and prickly-pear cactus.

Representative profile of an Ekalaka fine sandy loam in an area of Ekalaka-Desart fine sandy loams, gently undulating, in native grass, 660 feet south and 990 feet east of the northwest corner of sec. 36, T. 130 N., R. 105 W.:

A11—0 to 3 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; medium and fine crumb structure; slightly hard dry, very friable moist; many roots; neutral; clear, smooth boundary.

A12—3 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure parting to weak, medium and fine, subangular blocky structure; slightly hard dry, very friable moist; common roots; many pores; clear sand grains on peds; neutral; clear, smooth boundary.

A2—10 to 12 inches, light brownish-gray (2.5Y 6/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; weak, thick and medium, platy structure; slightly hard dry, very friable moist; common fine roots; moderately alkaline; abrupt, smooth boundary.

B21t—12 to 15 inches, light olive-brown (2.5Y 5/3) fine sandy loam, olive brown (2.5Y 4/3) moist; strong, coarse, columnar structure parting to strong, medium, angular blocky structure; extremely hard dry, very firm moist; common roots mainly along cracks; peds coated with dark grayish-brown (2.5Y 4/2) clay films; strongly alkaline; clear, smooth boundary.

B22t—15 to 21 inches, light olive-brown (2.5Y 5/3) fine sandy loam, olive brown (2.5Y 4/4) moist; strong, coarse, prismatic structure parting to strong medium, angular blocky structure; extremely hard dry, very firm moist; few fine roots; coarse soft lime masses; strongly alkaline; gradual, wavy boundary.

B3—21 to 28 inches, light olive-brown (2.5Y 5/3) loamy fine sand, olive brown (2.5Y 4/4) moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky structure; extremely hard dry, very friable moist; few fine roots; fine threads and masses of lime; common fine salt crystals; strong effervescence; strongly alkaline; gradual, wavy boundary.

C1ca—28 to 38 inches, olive-gray (5Y 5/2) loamy fine sand, olive (5Y 4/3) moist; weak, coarse and medium, subangular blocky structure; very hard dry very friable moist; many fine accumulations of lime; violent effervescence; strongly alkaline; gradual, wavy boundary.

C2—38 to 60 inches, light olive-gray (5Y 6/2), thinly stratified fine sandy loam and loamy fine sand, olive (5Y 4/3) moist; massive, but stratified with strata separating to weak, thick, platy structure; some streaks and accumulations of lime; strong effervescence; strongly alkaline.

The solum ranges from 22 to 38 inches in thickness. Depth to carbonates ranges from 16 to 34 inches. Depth to sedimentary beds generally is 42 to 52 inches, but it ranges from 40 to 60 inches in places. The A1 horizon is dark grayish-brown and grayish-brown sandy loam, fine sandy loam, or loamy fine sand. It ranges from medium acid to neutral. The A2 horizon ranges from less than ½ inch to 4 inches in thickness. The combined thickness of the A horizon above the columns is more than 10 inches and less than 20 inches. The B horizon is grayish-brown or light olive-brown sandy loam or fine sandy loam. It ranges from mildly alkaline to strongly alkaline. The sedimentary beds in the C horizon are sandy shale and soft sandstone. In places the C horizon is mottled.

Ekalaka soils are associated with Daglum, Desart, Ladner, and Zeona soils. They have a coarses textured B horizon than the Daglum soils. They have a claypan at a shallower depth than Desart soils. They have a claypan B horizon that is at a greater depth than that in Ladner soils. Ekalaka soils have a claypan B horizon that is lacking in Zeona soils.

Ekalaka-Desart fine sandy loams, gently undulating (EdB).—The soils in this complex are mainly gently undulating, but slopes range from 0 to 6 percent. They are on terraces, fans, and uplands. In places a pitted microrelief occurs where these soils are associated with Ladner soils. About 60 percent of the complex is Ekalaka fine sandy loam, 20 percent is Desart fine sandy loam, and 20 percent is included soils. Ekalaka soils have a claypan subsoil that is at a shallower depth than that in Desart

soils. Ekalaka fine sandy loam occupies the higher parts of the landscape. Desart fine sandy loam is in the flat and concave areas.

Ekalaka and Desart soils have the profile described as representative of their respective series.

Included with these soils in mapping are small areas of Vebar, Rhame, Ladner, and Absher fine sandy loams.

Runoff is slow in level or nearly level areas and medium in gently sloping areas. Soil blowing is a severe hazard. Salinity and alkalinity in the lower part of the subsoil limits availability of plant nutrients.

Much of the acreage of these soils is cultivated. Some areas remain in grasses. These soils are suited to cultivation if adequate management practices are used. Controlling soil blowing is a necessary part of good management. The soils are suited to grasses. Both soils in capability unit IIIe–3P; Sandy range site; Ekalaka part in windbreak suitability group 9; Desart part in windbreak suitability group 4.

Ekalaka-Ladner complex, rolling (E1C).—The soils in this complex are on uplands. Slopes are mainly 6 to 12 percent. Ekalaka fine sandy loam and sandy loam make up about 45 percent of the complex, Ladner fine sandy loam and sandy loam 25 percent, Ekalaka loamy fine sand 20 percent, and included soils 10 percent. In places a pitted microrelief occurs where these soils are associated with the Absher and Rhoades soils. Some areas have blowouts. Ekalaka soils have a claypan subsoil at a greater depth than Ladner soils.

The profile of Ekalaka soils is similar to that described as representative of the Ekalaka series, but the surface layer and subsoil are thinner, and the surface layer is loamy fine sand in a few places.

The profile of Ladner soils is similar to that described as representative of the Ladner series, but the surface layer is fine sandy loam or sandy loam.

Included with these soils in mapping are small areas of Vebar and Rhame fine sandy loams. Also included are 337 acres of sloping Daglum soils and 845 acres of sloping and strongly sloping Ekalaka, Zeona, and Ladner soils.

Runoff is medium where slopes are 6 to 9 percent and rapid where slopes are 9 to 12 percent. Soil blowing is a severe hazard.

Some areas of these soils are cultivated. Other areas remain in grasses. The soils of this complex that have less than 9 percent slopes are suited to cultivation if adequate management practices are used. Soils in this complex that have a surface layer of loamy fine sand or that have slopes of more than 9 percent are better suited to grazing. Measures are needed to control soil blowing and to maintain organic-matter content and fertility. Both soils in capability unit IVe–3P; Ekalaka part in Sandy range site; windbreak suitability group 9; Ladner part in Claypan range site; windbreak suitability group 9.

Ekalaka-Zeona-Ladner loamy fine sands, gently sloping (EmB).—In this complex are mainly gently sloping soils on terraces, fans, and uplands. Slopes range from 0 to 6 percent. The complex is 55 percent Ekalaka loamy fine sand, 20 percent Zeona loamy fine sand, 15 percent Ladner loamy fine sand, and 10 percent included soils. In places there is a pitted microrelief where the surface layer is eroded. Some areas have blowouts. Ekalaka soils have a claypan subsoil at a greater depth than Ladner soils. Zeona soils lack a claypan subsoil.

The profile of Ekalaka soils is similar to that described as representative of the Ekalaka series, but the surface layer is loamy fine sand.

The profile of Zeona soils is similar to that described as representative of the Zeona series.

Ladner soils have the profile described as representative of the Ladner series.

Included with these soils in mapping are small areas of Absher and Rhoades fine sandy loams.

Runoff is slow in level areas and medium in gently sloping areas. Soil blowing is a severe hazard.

Some areas of these soils are cultivated. Other areas remain in grasses. The soils are not well suited to cultivation because of the hazard of soil blowing, saline and alkaline conditions in the subsoil, and low available water capacity. Management practices to control soil blowing are needed to maintain organic-matter content and fertility. These soils are suited to grasses. All soils in capability unit IVe–2P; Ekalaka part in Sandy range site; windbreak suitability group 9; Zeona part in Thin Sands range site; windbreak suitability group 10; Ladner part in Claypan range site; windbreak suitability group 9.

Flasher Series

This series consists of shallow, excessively drained, sloping to steep soils on uplands. These soils formed in weathered sandstone.

In a representative profile the surface layer is grayish-brown fine sandy loam about 5 inches thick. Below this is very friable, light brownish-gray fine sandy loam about 3 inches thick. Beneath this is light brownish-gray loamy fine sand about 11 inches thick. This is underlain by soft sandstone that is light brownish gray to a depth of about 34 inches and light olive gray to a depth of 60 inches.

Permeability is rapid and moderately rapid. Available water capacity is very low. Fertility and organic-matter content are low.

Most areas of these soils are in native grasses, including prairie sandreed, needle-and-thread, and threadleaf sedge. Flasher soils generally are not suited to cultivated crops. Some areas that have slopes of less than 9 percent are cultivated along with the larger areas of associated Telfer and Vebar soil.

Representative profile of a Flasher fine sandy loam in an area of Flasher-Vebar complex, hilly, in native grass, 528 feet west and 230 feet south of the northeast corner of NW¼ sec. 25, T. 131 N., R. 101 W.:

A1—0 to 5 inches grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium and fine, subangular blocky structure parting to weak, fine, crumb structure; soft dry, very friable moist, nonsticky and nonplastic wet; neutral; abrupt, smooth boundary.

AC—5 to 8 inches, light brownish-gray (2.5YR 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, medium and fine, subangular blocky structure; soft dry, very friable moist, nonsticky and nonplastic wet; violent effervescence; moderately alkaline; clear, smooth boundary.

C1—8 to 12 inches, light brownish-gray (2.5Y 6/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; weak, medium and fine, subangular blocky structure and single grain; loose dry, nonsticky and nonplastic wet; violent effervescence; moderately alkaline; gradual, smooth boundary.

C2—12 to 19 inches, light brownish-gray (2.5Y 6/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; partly weathered sandstone; nonsticky and nonplastic wet; violent effervescence; moderately alkaline; gradual, wavy boundary.

C3—19 to 34 inches, light brownish-gray (5Y 5/2) soft sandstone, loamy fine sand when crushed, olive gray (5Y 5/2) moist; violent effervescence; moderately alkaline; gradual, wavy boundary.

C4—34 to 60 inches, light olive-gray (5Y 6/2) soft sandstone, loamy fine sand when crushed, olive gray (5Y 5/2) moist; strong effervescence; moderately alkaline.

Depth to sedimentary beds ranges from 10 to 20 inches. The soil is noncalcareous in some places. The A1 horizon ranges from 2 to 8 inches in thickness and is light brownish gray, grayish brown, or dark grayish brown. It is neutral to mildly alkaline. It is sandy loam, fine sandy loam, or loamy fine sand. The A1 horizon is underlain by partly weathered sandstone in places. The sandstone is soft in places and very hard in others. It contains iron and manganese stains in some areas. In places pockets and seams of carbonates are below the A horizon.

Flasher soils are associated with Cabba, Lefor, Telfer, and Vebar soils. They are coarser textured than Cabba soils, and they are shallower to sandstone than Telfer soils. They lack the B horizon of the Lefor and Vebar soils.

Flasher complex, steep (FeE).—The soils in this complex are on uplands that are dissected by deeply incised drainageways. Slopes range from 15 to 40 percent but are mainly greater than 20 percent. The complex is 60 percent Flasher fine sandy loam and loamy fine sand; 25 percent Vebar fine sandy loam, sandy loam, and loamy fine sand; and 15 percent included soils. This Flasher soil has more sandstone outcrop (fig. 10) and contains more loamy fine sand than the Flasher soil in the Flasher-Vebar complex, hilly. In a few places Telfer soils, instead of Vebar soils, are in a complex with Flasher soils. Flasher soils are in the higher positions on the landscape, and Vebar soils are in the lower positions.

The profile of Flasher soils is similar to that described as representative of the Flasher series, but the surface layer is thinner, and the sandstone in the substratum is very hard in places.

The profile of Vebar soils is similar to that described as representative of the Vebar series.

Included with these soils in mapping are small areas of Cabba loam, Telfer loamy fine sand, Ekalaka fine sandy loam, Wayden clay loam, and Rhoades loam. Also included are a few scattered areas where the soils are stony or where the soils on the hills are capped by a thin layer of gravel or are barren.

Runoff is rapid. Soil blowing is a hazard, and available water capacity is very low.

Most of the acreage of these soils is in grasses. These soils are not suited to cultivation, because they are too shallow and too steep.

Soil blowing is a concern if these soils are overgrazed. Management practices that maintain a good grass cover and fertility are needed. Capability unit VIe–Sw; Shallow range site; windbreak suitability group 10.

Flasher-Vebar complex, hilly (FhD).—In this complex are soils on uplands that are dissected by small drainageways. Slopes are mainly 10 to 15 percent, but range from 3 to 15 percent. About 60 percent of the complex is Flasher fine sandy loam or loamy fine sand, 30 percent Vebar fine sandy loam, and 10 percent included soils. Flasher soils have a thinner surface layer and subsoil than Vebar soils and are in the steeper convex positions on the landscape.

The profile of Flasher soils is similar to the one described as representative of the Flasher series, but in places the surface layer is loamy fine sand. Also, in a few places the sandstone in the substratum is hard.

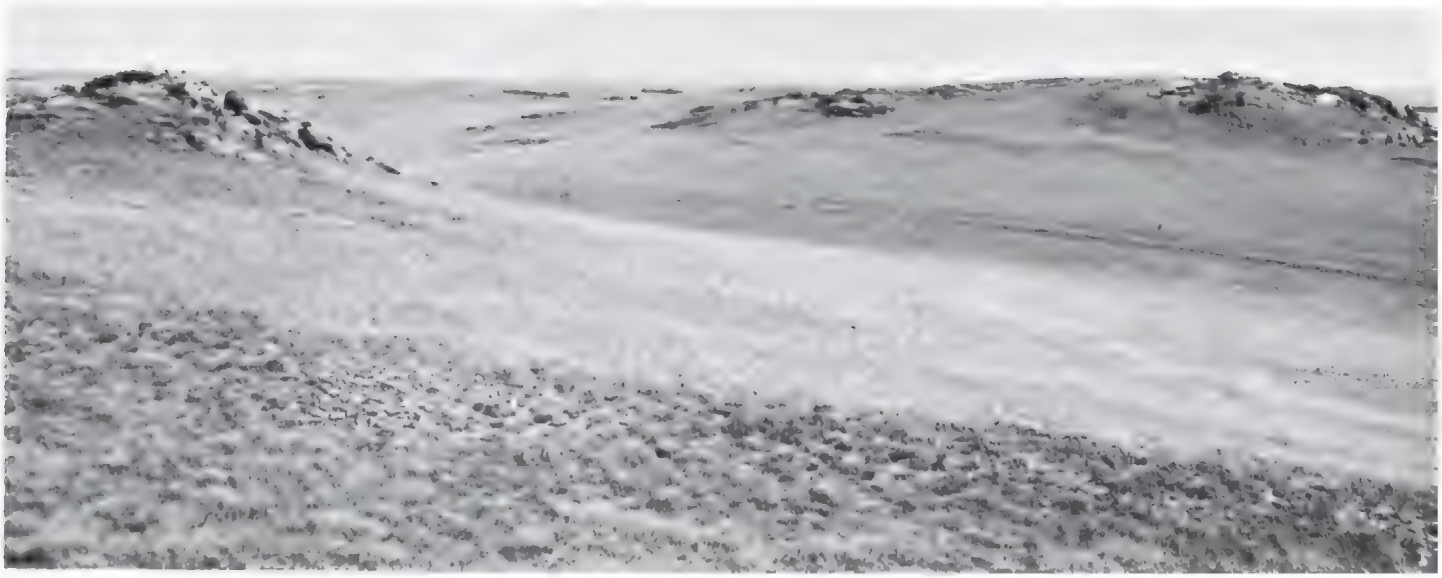

Figure 10.—Sandstone outcrop in an area of Flasher soils.

The profile of Vebar soils is similar to that described as representative of the Vebar series, but the surface layer and subsoil are thinner.

Included with the soils of this complex in mapping are small areas of Cabba loam, Ekalaka fine sandy loam, Wayden clay loam, and Rhoades loam. Also included are a few scattered areas where the soils are stony or where the soils on the hills and ridges are capped by a thin layer of gravel. Also included are areas that are moderately eroded and where erosion has exposed the lighter colored subsoil and substratum in places.

Runoff is rapid where slopes are 9 to 15 percent and medium where slopes are 3 to 9 percent. Soil blowing is a hazard on these soils, and the available water capacity in Flasher soils is very low.

Most areas of these soils are in grasses. Areas in native grass are suited to range. In a few places, small areas of these soils are cultivated along with adjoining areas of soils that are better suited to cultivation. Erosion has been moderate in some areas. If these soils are overgrazed or tilled, soil blowing and the loss of organic matter are concerns. Management practices are needed that maintain good grass cover, organic-matter content, and fertility. Both soils in capability unit VIe–Sw; Flasher part in Shallow range site; windbreak suitability group 10; Vebar part in Sandy range site; windbreak suitability group 7.

Flasher and Vebar very stony soils (Fm).—In this mapping unit are soils on uplands. These soils have slopes of 0 to 20 percent. Some areas are part Flasher and part Vebar soils. Other areas are all Flasher soils or all Vebar soils. The surface layer is 25 to 75 percent stones of chert, flint, and sandstone. Stones range from 5 to 48 inches in length.

The profile of Flasher soils is similar to the one described as representative of the Flasher series, but the surface layer is thicker, contains stones, and in places is loamy fine sand.

The profile of Vebar soils is similar to the one described as representative of the Vebar series, but the surface layer is thicker and contains stones.

Included with these soils in mapping are small areas of Amor and Cabba loams.

Runoff is medium in areas that have slopes of less than 9 percent and rapid in steeper areas.

All areas of these soils are in native grasses and are used for grazing. Some areas have potential for wildlife habitat. The stones are easily accessible in most places and can be used as construction materials for dams and roads. Management practices that maintain organic-matter content and fertility and control erosion are needed. Both soils in capability unit VIIs–Sy; Flasher part in Shallow range site; windbreak suitability group 10; Vebar part in Sandy range site; windbreak suitability group 10.

Fleak Series

This series consists of shallow, excessively drained, sloping to steep soils on uplands. These soils formed in material weathered from sandstone.

In a representative profile the surface layer is grayish-brown loamy fine sand about 3 inches thick. Below this is loose, grayish-brown loamy fine sand about 5 inches thick. The next layer, about 9 inches thick, is light brownish-gray loamy fine sand that is underlain by pale-yellow soft sandstone.

Permeability is rapid, and available water capacity is very low. Organic-matter content and fertility are low.

Most areas of these soils are in native grasses, including prairie sandreedgrass, needle-and-thread, and threadleaf sedge. Fleak soils are not suited to cultivated crops, but some areas where slopes are less than 9 percent are cultivated along with the larger areas of associated Rhame and Zeona soils.

Representative profile of a Fleak loamy fine sand in an area of Fleak-Rhame complex, hilly, in native grass, 1,060 feet north and 850 feet west of the center of sec. 30, T. 129 N., R. 106 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10 YR 3/2) moist; very weak, fine, crumb structure parting to single grain; loose dry; many mated roots; neutral; clear boundary.

C1—3 to 8 inches, grayish-brown (2.5Y 5/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; very weak, medium, subangular blocky structure parting to single grain; loose dry; many roots; strong effervescence; moderately alkaline; gradual boundary.

C2—8 to 17 inches, light brownish-gray (2.5Y 6/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; single grain; few to common roots; strong effervescence; moderately alkaline; clear, wavy boundary.

C3—17 to 60 inches, pale-yellow (2.5Y 7/3) soft-layered sandstone, light olive brown (2.5Y 5/3) moist; massive; hard and brittle dry, very friable moist; a few roots in seams of 17- to 25-inch layer; strong effervescence; moderately alkaline.

Depth to sedimentary beds of sandstone ranges from 10 to 20 inches. In some places the sandstone beds are noncalcareous. The A horizon is grayish-brown or light brownish-gray loamy fine sand or fine sandy loam and is neutral or mildly alkaline in reaction. It is underlain by partly weathered sandstone in places. Most of the sandstone is soft, but in a few places it is hard. In places the C horizon has brown or reddish-brown stains of iron or manganese oxides. In some places the C horizon has pockets and seams of carbonates.

Fleak soils are associated with Cabbart, Rhame, Tusler, and Zeona soils. They are coarser textured than Cabbart soils and have a thinner A horizon than Zeona soils. They lack the B horizon of Rhame soils. They are not so deep to sandstone as the Tusler soils.

Fleak-Rhame complex, hilly (FnD).—In this complex are soils that have slopes that range from 3 to 15 percent but are mainly 9 to 15 percent. The soils are in areas dissected by small drainageways. This complex is about 35 percent Fleak loamy fine sand and fine sandy loam, 30 percent Rhame fine sandy loam, 20 percent Tusler soils, and 15 percent other soils. Fleak loamy fine sand and fine sandy loam are in the high convex positions on the landscape, and Rhame soils are in the lower positions. Tusler soils are in areas between the Fleak and Rhame soils. In some places Zeona soils, instead of, Rhame soils are in complex with Fleak soils.

The Fleak soils have a profile similar to that described as representative of the Fleak series, except that in some places the surface layer is fine sandy loam.

The profile of Rhame soils is simlar to that described as representative of the Rhame series, but the surface layer and subsoil are thinner.

The profile of Tusler soils is similar to that described as representative of the Tusler series.

Included with these soils in mapping are small areas of Cabbart and Rhoades loams. Also included are some moderately eroded areas where cultivation has exposed the lighter colored subsoil and substratum.

Runoff is rapid where slopes are 9 to 15 percent and medium where slopes are 3 to 9 percent. Soil blowing is a hazard on these soils, and available water capacity is very low in Fleak soils.

Most of the acreage of these soils is in grasses. Some areas where slopes are less than 9 percent are cultivated, mainly in small tracts along with areas of other soils that are better suited to cultivation. These soils are better suited to grasses than to most other uses.

Soil blowing and loss of organic matter are concerns of management if these soils are overgrazed or tilled. Management practices are needed that maintain good grass cover, organic-matter content, and fertility. Both soils in capability unit VIe–Sw; Fleak part in Shallow range site; windbreak suitability group 10. Rhame part in Sandy range site; windbreak suitability group 7.

Fleak rocky complex, steep (FoE).—The soils in this complex are on uplands. Slopes generally are more than 20 percent but range from 15 to 40 percent. This complex is mainly Fleak soils and lesser amounts of Tusler soils and rock outcrops. Fleak and Tusler soils are mainly on smooth slopes. Outcrops are mainly on ridge crests at the edge of valleys that are crossed by deeply cut streams. The surface layer is mainly fine sandy loam and loamy fine sand. The outcrops are silty shale and sandstone. In places some of the ridges and knolls are capped with a thin layer of gravel. About 10 to 30 percent of the acreage is barren. A few cedar, ash, boxelder, and shrubs are in the steep ravines.

The profile of Fleak soils is similar to that described as representative of the Fleak series, but the surface layer and subsoil are thinner, and in some places the surface layer is fine sandy loam.

The profile of Tusler soils is similar to that described as representative of the Tusler series, but the solum is thinner, and in places the surface layer is fine sandy loam or sandy loam.

Included with these soils in mapping are small areas of Absher, Cabbart, and Patent loams and Rhame fine sandy loam.

Runoff is rapid and very rapid.

All areas of these soils are used for grazing. They are not suited to cultivation. Deep ravines, or gulches, provide protection for grazing animals in winter and habitat for deer, antelope, and upland birds. Erosion is a concern if these soils are overgrazed. Management practices that maintain good grass cover and fertility are needed. Capability unit VIIe–Sw; Shallow range site; windbreak suitability group 10.

Fleak-Tusler complex, steep (FtE).—In this complex are soils on uplands that have deeply incised drainageways. Slopes range from 15 to 40 percent but are dominantly greater than 20 percent. These soils have more sandstone outcrops and contain more Tusler soils than the soils in the Fleak-Rhame complex, hilly. This complex is 30 percent Fleak fine sandy loam and loamy fine sand; 25 percent Tusler fine sandy loam, sandy loam, and loamy fine sand; 25 percent Rhame fine sandy loam and sandy loam; and 15 percent other soils. Fleak soils are in the high convex positions on the landscape, and the Tusler soils are immediately below them. Rhame soils are gently sloping and are in the lower concave positions.

The profile of Fleak soils is similar to that described as representative of the Fleak series, but the surface layer is thinner and in places is fine sandy loam.

The profile of Tusler soils is similar to that described as representative of the Tusler series, but in places the surface layer is fine sandy loam or sandy loam.

Included with these soils in mapping are small areas of Absher, Cabbart, and Ladner loams. Also included are a few scattered areas where the hills and ridges are capped with a thin layer of gravel.

Runoff is rapid.

Very little of the acreage of these soils is cultivated. Areas in native grasses are well suited to grazing. These soils are not suited to cultivation. Soil blowing is a concern if the soils are overgrazed. Management practices that maintain good grass cover and fertility are needed. Both soils in capability unit VIe–Sw; Fleak part in Shallow range site; windbreak suitability group 10. Tusler part in Thin Sands range site; windbreak suitability group 10.

Glendive Series

This series consists of deep, well-drained, nearly level to undulating soils on bottom lands and low terraces. These soils formed in recent alluvium.

In a representative profile the surface layer is light brownish-gray fine sandy loam about 7 inches thick. The underlying material is light brownish-gray or grayish-brown, stratified sandy loam, fine sandy loam, loamy fine sand, and loam, but it is generally fine sandy loam.

Permeability is moderately rapid, and available water capacity is moderate. Organic-matter content is moderately low, and fertility is medium. Tilth is good to poor. These soils are highly susceptible to soil blowing.

These soils are used for crops and pasture. If adequate management practices are used, these soils are suited to cultivation. They are suited to irrigation. The native vegetation consists of prairie sandreed, needle-and-thread, blue grama, and sagebrush.

Representative profile of Glendive fine sandy loam, nearly level, in a cultivated field, 75 feet east and 428 feet south of the center of sec. 10, T. 130 N., R. 106 W.:

Ap—0 to 7 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, subangular blocky structure and fine, crumb structure; soft dry, very friable moist; common fine roots; mildly alkaline; abrupt, smooth boundary.

C1—7 to 15 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; stratified; massive breaking to platy structure; thin layers of sandy loam and very fine sand; slightly hard dry, very friable moist; common roots and pores; strong effervescence; moderately alkaline; gradual, wavy boundary.

C2—15 to 26 inches, light yellowish-brown (2.5Y 6/3) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive breaking to weak platy structure; stratified, few, very thin layers of silt loam and loam of light gray (2.5Y 7/2); slightly hard dry, very friable

moist; few fine roots and few pores; strong effervescence; moderately alkaline, clear, smooth boundary.

C3—26 to 60 inches, grayish-brown and light brownish-gray (2.5Y 5/2 and 6/2) stratified fine sandy loam, loamy fine sand, and loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard dry, very friable and loose moist; few fine roots and pores; strong effervescence; moderately alkaline.

Texture is mainly stratified fine sandy loam, sandy loam, loam, and loamy fine sand, which averages fine sandy loam. The layers range from 1 to 10 inches in thickness. In some places the surface layer is calcareous. In places layers are noncalcareous, and some are mottled. Buried layers and gravel lenses or fragments are in some places. The A horizon is light brownish-gray or grayish-brown loam, fine sandy loam, or sandy loam. It is mildly alkaline or moderately alkaline and 4 to 9 inches thick.

Glendive soils are associated with Hanly, Havre, and Toby soils. Glendive soils are finer textured than the Hanly soils, but they are coarser textured than Havre soils. They lack the B horizon of Toby soils.

Glendive fine sandy loam, nearly level (GdA).—This soil is on bottom lands and low terraces. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Hanly fine sandy loam, Havre and Absher loams, and poorly drained soils in a few, small, old oxbows of stream channels.

Runoff is slow. Runoff in spring and seasonal storms sometimes flood this soil. This soil is highly susceptible to soil blowing.

This soil is suited to hay, crops, and pasture. Some areas are suitable for irrigation. If adequate management practices are used, this soil is suited to cultivated crops. It is well suited to trees. Management practices that control soil blowing and maintain organic-matter content and fertility are needed. Capability unit IIIe–3; Overflow range site; windbreak suitability group 1.

Glendive fine sandy loam, undulating (GdB).—This soil is on alluvial fans bordering the bottom lands and on alluvial fans on uplands. Slopes range from 3 to 6 percent. The profile of this soil is similar to that described as representative of the series, but it is not so coarse textured below a depth of 30 inches.

Included with this soil in mapping are small areas of Patent, Havre, and Absher loams and Velva fine sandy loam. Also included are a few areas where slopes are more than 6 percent.

Runoff is medium. This soil is highly susceptible to soil blowing.

This soil is used for hay, crops, and pasture. It is suited to cultivated crops if adequate management practices are used. Management practices that control soil blowing and maintain organic-matter content and fertility are needed. Capability unit IIIe–3; Sandy range site; windbreak suitability group 1.

Grail Series

This series consists of deep, well-drained, nearly level to gently sloping soils in swales and depressions. These soils formed in material washed from adjacent areas.

In a representative profile the surface layer is dark grayish-brown silty clay loam about 7 inches thick. The subsoil, about 18 inches thick, is firm silty clay that is dark grayish brown in the upper part and grayish brown in the lower part. The underlying material is silty clay that is grayish brown to a depth of about 25 inches and olive below this depth.

Permeability is moderately slow. Available water capacity, organic-matter content, and fertility are high. Tilth is fair to good.

Nearly all areas of these soils are cultivated. A few areas are in native grasses consisting mainly of western wheatgrass, green needlegrass, and blue grama. These soils are suited to cultivated crops, trees, and grasses commonly grown in the county.

Representative profile of Grail silty clay loam, nearly level, in a cultivated field, 1,617 feet east and 790 feet south of northwest corner of sec. 26, T. 131 N., R. 99 W.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure parting to strong, fine, granular structure; hard dry, friable moist, sticky and plastic wet; neutral; abrupt, smooth boundary.

B21t—7 to 15 inches, dark grayish-brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) and coats on peds of very dark brown (10YR 2/2) moist; weak, coarse, prismatic structure parting to strong, coarse and medium, angular blocky structure; very hard dry, firm moist, very sticky and very plastic wet; neutral; clear, smooth boundary.

B22t—15 to 25 inches, grayish-brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) and coats of very dark brown (10YR 2/2) moist; weak, coarse, prismatic structure parting to strong, medium and fine, angular blocky structure; very hard dry, firm moist, very sticky and very plastic wet; neutral; gradual, wavy boundary.

C1—25 to 35 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) and streaks of very dark grayish brown (10YR 3/2) moist; moderate, medium and fine, angular blocky structure; very hard dry, firm moist, very sticky and very plastic wet; slight effervescence; mildly alkaline; gradual, wavy boundary.

C2—35 to 46 inches, olive (5Y 5/2) silty clay, olive (5Y 4/3) and streaks of very dark grayish brown (10YR 3/2) moist; very hard dry, very sticky and very plastic wet; violent effervescence; common segregations of thread lime; moderately alkaline: gradual, wavy boundary.

C3—46 to 60 inches, olive (5Y 5/3) silty clay, olive (5Y 4/3) moist; hard dry, firm moist, very sticky and very plastic wet; violent effervescence; many segregations of thread lime; moderately alkaline.

The solum ranges from 20 to 48 inches in thickness. Depth to carbonates ranges from 15 to 40 inches. None to many prominent nests of gypsum crystals are in the soil. The A horizon is dark grayish-brown or very dark grayish-brown clay loam, silt loam, or silty clay loam as much as 18 inches thick. It is slightly acid or neutral in reaction. The B horizon is grayish-brown or dark grayish-brown clay loam, silty clay loam, or silty clay. It ranges from neutral to moderately alkaline in reaction and is moderate or strong in structure. The C horizon is clay loam, silty clay loam, or silty clay.

Grail soils are associated with Arnegard, Reeder, Regan, Regent, and Savage soils. They have a finer textured B horizon than Arnegard soils. They are darker colored to a greater depth than Reeder, Regent, and Savage soils and are less saline than Regan soils.

Grail silt loam, nearly level (GeA).—This soil is in swales, depressions, and drainageways. Most areas are long and narrow. This soil receives runoff from adjacent areas. The profile of this soil is similar to that described

as representative of the series, but the surface layer is silt loam.

Included with this soil in mapping are small areas of Arnegard, Belfield, Regan, and Rhoades silt loams. Also included are small areas of Grail soils, saline.

Runoff is slow to medium. In some places the hazard of erosion is none to slight, but small gullies have formed in some areas where runoff water has concentrated. Although this soil is resistant to soil blowing, measures are needed to maintain organic-matter content and fertility.

Most areas of this soil are cultivated. A few scattered areas remain in grasses. This soil is well suited to cultivated crops. Capability unit IIc–6; Overflow range site; windbreak suitability group 1.

Grail silt loam, gently sloping (GeB).—This soil is in swales and drainageways and on foot slopes of uplands. Most slopes are 3 to 6 percent, but slopes range from 3 to 9 percent. The profile of this soil is similar to that described as representative of the series, but the surface layer is silt loam.

Included with this soil in mapping are small areas of Arnegard, Belfield, Rhoades, and Shambo loams.

Runoff is medium, and the hazard of erosion is slight to moderate. In some places small gullies have formed where runoff water has concentrated. Controlling water erosion, conserving moisture, and maintaining organic-matter content and fertility are the main needs of management.

Most areas of this soil are cultivated. A few scattered areas remain in native grasses. This soil is suited to cultivated crops commonly grown in the county if adequate management practices are used. Capability unit IIe–6; Silty range site; windbreak suitability group 1.

Grail silty clay loam, nearly level (G1A).—This soil is in swales, depressions, and drainageways. Most areas are long and narrow. This soil receives extra moisture in the form of runoff from adjacent areas. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Belfield, Morton, Regent, and Savage silty clay loams and Lawther silty clay.

Runoff is slow to medium. In most places the hazard of erosion is none to slight, but small gullies have formed in some areas where runoff water has concentrated.

Most areas of this soil are cultivated, but a few scattered areas remain in grasses. This soil is well suited to cultivated crops. Capability unit IIc–7; Overflow range site; windbreak suitability group 1.

Grail silty clay loam, gently sloping (G1B).—This soil is in swales and drainageways and on foot slopes on uplands. Most slopes are 3 to 6 percent, but they range from 3 to 9 percent. The profile of this soil is similar to that described as representative of the series, but the surface layer and the subsoil are thinner.

Included with this soil in mapping are small areas of Belfield, Morton, Regent, and Savage silty clay loams.

Runoff is medium, and the hazard of erosion is slight to moderate. In some places small gullies have formed where runoff water has concentrated. Controlling water erosion, conserving moisture, and maintaining organic-matter content and fertility are the main needs of management.

Most areas of this soil are cultivated. A few scattered areas remain in native grasses. This soil is suited to cultivated crops commonly grown in the county if adequate management practices are used. Capability unit IIe–7; Silty range site; windbreak suitability group 1.

Grail soils, saline (Gm).—These soils are nearly level and are in swales and draws and on foot slopes on uplands and along the edge of alluvial fans. Areas are small. These soils have a profile similar to that described as representative of the series, but they are moderately well drained to poorly drained, have a seasonal water table within 30 inches of the surface, and are moderately saline in the upper part of the profile. The surface layer is silt loam or silty clay loam. Internal drainage is slow. The seasonal water table causes a saline condition that is worse in some years than in others. Salt spots are on 5 to 50 percent of the surface area.

Included with these soils in mapping are small areas of Arnegard and Grail silt loams, Alluvial land, strongly saline, and Daglum loam. The Arnegard and Grail silt loams generally are near the outer edges of areas of these soils.

These soils have limited value for crops. Spotty germination and emergence of new seedlings is caused by salts in these soils. In some of the wetter areas, artificial drainage is needed if crops are to be grown. Drainage is not practical in most of these areas, because outlets are difficult to establish. These soils are better suited to grazing than to most other uses. Capability unit IIIws–4; Saline Lowland range site; windbreak suitability group 10.

Grail-Rhoades silty clay loams, nearly level (GoA).—The soils in this complex are in swales, depressions, and drainageways. The complex is 55 to 85 percent Grail silt loam and silty clay loam, 5 to 35 percent Rhoades silt loam and silty clay loam, 15 to 25 percent Daglum and Belfield silt loam and silty clay loam, and 5 to 15 percent other soils. Most areas are long and narrow and receive runoff from adjacent areas. Most areas that are in native grasses have a pitted microrelief. The pitted areas, known locally as slick, scab, pan, or gumbo spots, support little or no vegetation and absorb water slowly. In most places these spots consist of Rhoades soils where the material in the surface layer has been lost through erosion. In cultivated areas these spots and the other Rhoades soils are dispersed and puddled.

The profile of the Grail soils is similar to that described as representative of the Grail series, but the content of salt in the lower part of the subsoil and in the substratum is higher and in places the surface layer is silt loam.

The profile of the Rhoades soils is similar to that described as representative of the Rhoades series, but it is darker colored to a greater depth, and the surface layer is silty clay loam and in places silt loam.

Included with these soils in mapping are small areas of Daglum silty clay loam, Shambo silt loam, Savage silty clay loam, and Grail soils, saline.

Runoff is slow, and the hazard of erosion is slight. Available water capacity is moderate to low where Daglum and Rhoades soil occur, and this hinders crop growth, especially during years of below-normal rainfall. Improving tilth, conserving moisture, and maintaining organic-

matter content and fertility are the main needs of management.

Much of the acreage of these soils is cultivated. The soils are suited to most crops commonly grown in this county. Some crops, especially corn, emerge and grow slowly in the slick spots on Rhoades soils. Both soils in capability unit IIIs–P; Grail part in Overflow range site; windbreak suitability group 1; Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Grail-Rhoades silty clay loams, gently sloping (GoB).—The soils in this complex are in swales and drainageways and on foot slopes on uplands. The complex is 60 to 85 percent Grail silt loam and silty clay loam, 5 to 35 percent Rhoades silt loam and silty clay loam, 15 to 25 percent Daglum and Belfield silt loam and silty clay loam, and 5 to 15 percent other soils. Most areas that are in native grasses have a pitted microrelief. The pitted areas, known locally as slick, scab, pan, or gumbo spots, support little or no vegetation and absorb water slowly. In most places these spots consist of Rhoades soils where the material in the surface layer has been lost through erosion. In cultivated areas these spots are dispersed and puddled.

The profile of the Grail soils is similar to that described as representative of the Grail series, but the content of salt in the lower part of the subsoil and in the substratum is higher, and in places the surface layer is silt loam.

The profile of the Rhoades soils is similar to that described as representative of the Rhoades series, but it is darker colored to a greater depth, and the surface layer is silty clay loam and, in places, silt loam.

Included with these soils in mapping are small areas of Savage and Morton silty clay loams and Grail soils, saline.

Runoff is medium, and the hazard of water erosion is moderate to severe. Controlling water erosion, improving tilth, conserving moisture, and maintaining organic-matter content and fertility are the main needs of management. Available water capacity is moderate to low where Daglum and Rhoades soils occur, and this hinders crop growth, especially during years of below-normal rainfall.

Much of the acreage of these soils is cultivated. The soils are suited to most crops commonly grown in the county. Some crops, especially corn, emerge and grow slowly in slick spots on Rhoades soils. Both soils in capability unit IIIe–P; Grail part in Silty range site; windbreak suitability group 1. Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Gravel Pit

Gravel pit (Gp) consists of areas from which sand and gravel have been removed. Most areas were not leveled after the sand and gravel were removed. Slopes range from very steep on the edges of pits to nearly level in some places on the bottoms of pits. Snowberry, wild roses, sweet clover, weeds, some brush, and a few trees grow in thin stands. Many trees and some grasses have established themselves in a large gravel pit about 3 miles southwest of Rhame. Capability unit VIIIs; range site not assigned; windbreak suitability group 10.

Hanly Series

This series consists of deep, excessively drained, nearly level soils adjacent to stream channels. Nearly all areas are subject to flooding. These soils formed in recently deposited, loose, very sandy alluvium.

In a representative profile the surface layer is light brownish-gray loamy fine sand about 6 inches thick. The underlying material is light brownish-gray and light-gray stratified loamy fine sand and fine sand that has thin strata of very fine sand, fine sandy loam, and coarse sand.

Permeability is rapid, and available water capacity and fertility are low. Organic-matter content is moderate.

Some areas of these soils are cultivated, but most are used for pasture and hay. The native vegetation consists mainly of prairie sandreedgrass and sagebrush. Cottonwood trees are in some areas. If the native trees and grasses are destroyed, Hanly soils are highly susceptible to soil blowing.

Representative profile of Hanly loamy fine sand, in grass, 1,155 feet south and 1,610 feet east of the northwest corner of sec. 10, T. 130 N., R. 106 W.:

A1—0 to 6 inches, light brownish-gray (2.5Y 6/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; weak, fine, crumb structure and single grain; soft dry, very friable moist; many roots; slight effervescence; mildly alkaline; clear, wavy boundary.

C—6 to 60 inches, light brownish-gray (2.5Y 6/2) and light-gray (2.5Y 7/2) stratified loamy fine sand and fine sand, and a few very thin strata of very fine sand, fine sandy loam, and coarse sand; loose dry; strong effervescence; moderately alkaline.

Texture is mainly loamy fine sand that has strata of fine sandy loam, sandy loam, very fine sand, and coarse sand, which average loamy fine sand. The layers range from 1 to 10 inches in thickness. Buried layers and gravel lenses or fragments are in some places. In some places the soil is noncalcareous or has layers that are noncalcareous. In some places the soil is mottled. The A horizon is light bownish-gray, grayish-brown, or light-gray loamy fine sand or fine sandy loam.

Hanly soils are associated with Glendive, Havre, and Zeona soils. They are coarser textured than Glendive and Havre soils. They are more stratified than Zeona soils and are subject to flooding.

Hanly loamy fine sand (Ha).—This soil is on flood plains adjacent to stream channels. Slopes range from 0 to 6 percent. The general relief is nearly level, but the microrelief is hummocky from the action of wind and water. This soil has the profile described as representative of the series. This soil is subject to flooding from runoff when storms are severe and runoff is heavy in spring. Surface water is rapidly absorbed.

Included with this soil in mapping are small areas of Glendive fine sandy loam, Riverwash, and Zeona fine sand. Also included are small areas of Hanly loamy fine sand, gently sloping.

Runoff is slow. This soil is highly susceptible to soil blowing. The main concerns of management are controlling soil blowing and grazing.

Most areas of this soil are used for pasture and hay. It is not suited to cultivated crops, but some areas are cultivated. This soil is suited to hay and pasture if proper management is used. Capability unit VIe–TSa; Thin Sands range site; windbreak suitability group 7.

Hanly soils, channeled (Hc).—The soils in this mapping unit are on flood plains. Slopes range from 0 to 6 percent but most are less than 3 percent. Channels 5 to 12 feet deep meander through the areas. In places these soils are subject to flooding from runoff in spring and seasonal storms. Surface water is rapidly absorbed.

The profile of Hanly soils is similar to that described as representative of the Hanly series, but the surface layer is fine sandy loam in most places.

Included with these soils in mapping are areas of Glendive fine sandy loam. Also included are small areas of Ekalaka loamy fine sand and fine sandy loam; Ladner fine sandy loam; Alluvial land, strongly saline; scattered areas of variously textured alluvial soils; and terrace remnants and bluffs.

Runoff is slow, except in stream channels.

These soils are too channeled and too susceptible to soil blowing to be used for cultivated crops. Nearly all areas are used for pasture. Management that maintains a plant cover on these soils helps to maintain organic-matter content and fertility. Capability unit VIe–Ov; Overflow range site; windbreak suitability group 7.

Havre Series

This series consists of deep, well-drained, level, nearly level, and gently sloping soils on bottom lands and low terraces. These soils formed in recent alluvium.

In a representative profile the surface layer is light brownish-gray loam about 5 inches thick. Below this is grayish-brown loam, about 7 inches thick, that is underlain by grayish-brown stratified alluvium of loam, fine sandy loam, and very fine sandy loam, which averages loam.

Permeability is moderate. Available water capacity is moderate to high, and organic-matter content is moderate. Fertility is medium, and tilth is fair to good.

These soils are used for crops and pasture. They are suited to cultivated crops. They are suited to irrigation. The native vegetation consists of green needlegrass, western wheatgrass, blue grama, and sagebrush.

Representative profile of Havre loam in native grass, 825 feet east and 800 feet north of the southwest corner of sec. 15, T. 130 N., R. 106 W.:

A1—0 to 5 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, fine, crum structure; slightly hard, dry, friable, moist, slightly sticky and slightly plastic wet; mildly alkaline; abrupt, smooth boundary.

C1—5 to 7 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, thin, platy structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; mildly alkaline; clear, smooth boundary.

C2—7 to 12 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, thin, platy, structure; hard dry, friable moist, slightly sticky and slightly plastic wet; mildly alkaline; clear, smooth boundary.

C3—12 to 60 inches, grayish-brown (2.5Y 5/2) stratified alluvium of loam, fine sandy clay loam, and very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; strong effervescence; few segregations of carbonates between depths of 12 to 23 inches and 28 to 30 inches.

The soil is stratified very fine sandy loam, loam, and silt loam, which average loam. Layers range from one to several inches in thickness. In some places the soil is calcareous throughout. In some places some layers are noncalcareous. Layers of fine sandy loam and gravel lenses or fragments are in some places, and some are mottled. The A horizon is light brownish-gray or grayish-brown loam, silt loam, clay loam, and silty clay loam. It is mildly alkaline or moderately alkaline.

Havre soils are associated with the Glendive, Korchea, Straw, and Wolf Point soils. They are finer textured than Glendive soils and lighter colored than Korchea and Straw soils. They are coarser textured than Wolf Point soils.

Havre loam (He).—This soil is on bottom lands and low terraces. Most slopes are less than 3 percent, but they range from 0 to 6 percent. The relief is generally level, but it is undulating in a few places where old stream channels cross the bottom lands. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Glendive fine sandy loam, Havre clay loam, and Korchea clay loam, wet variant.

Runoff is slow where the soil is level and medium where gently sloping. The hazard of erosion is slight. In places this soil is subject to flooding from runoff in spring and seasonal storms. The main need of management is conserving moisture.

This soil is used for hay, crops, and pasture. It is suited to all crops commonly grown in the county. Some areas are suitable for water spreading and irrigation. Although erosion is not a major hazard, management practices that control soil blowing are needed and help maintain organic-matter content and fertility. Capability unit IIe–4L; Overflow range site; windbreak suitability group 1.

Havre clay loam (Hm).—This nearly level soil is on bottom lands. The relief is mainly level, but it is undulating in a few places where old stream channels cross the bottom lands. The profile of this soil is similar to that described as representative of the series, but the surface layer is clay loam.

Included with this soil in mapping are small areas of Havre loam, Korchea clay loam, and Korchea clay loam, wet variant.

Runoff is slow to medium, and the hazard of erosion is slight. Runoff in spring and storms in summer sometimes flood this soil. The main need of management is conserving moisture.

This soil is suited to all crops commonly grown in the county. Some areas are suitable for water spreading or irrigation. Measures are needed to maintain fertility and organic-matter content. Capability unit IIe–4L; Overflow range site; windbreak suitability group 1.

Heil Series

This series consists of deep, level and nearly level, poorly drained soils in undrained basins and depressions. The relief is flat. These soils have a claypan subsoil. They formed in clayey material that washed into the basins.

In a representative profile the surface layer is light brownish-gray silty clay loam about 1½ inches thick. The firm, grayish-brown, silty clay subsoil, about 16½ inches thick, has salt masses at a depth of about 13 inches. The underlying material is light olive-gray clay that contains common salt masses.

Permeability is very slow. Available water capacity and organic-matter content are moderate. Fertility is medium. These soils are ponded for a few days to several weeks in most years. Tilth is poor.

These soils are used for crops, hay, and pasture. Where these soils are cultivated, the surface layer is dispersed and puddled. They are better suited to hay and pasture than to most other uses. In some places these soils have an excellent stand of western wheatgrass. The native vegetation includes western wheatgrass and sedges.

Representative profile of Heil silty clay, in an area of McKenzie and Heil silty clays, in native grass, 35 feet north and 60 feet east of the southwest corner of NW¼ sec. 2, T. 131 N., R. 100 W.:

A2—0 to 1½ inches, brownish-gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; patches, 1/16 to ⅛ inch in size, of white (N 8/0), dark grayish brown (2.5Y 4/2) moist; few, fine, faint mottles of yellowish brown (10YR 5/6), dark yellowish brown (10YR 4/4) moist; weak, very fine, subangular blocky structure, thin, platy structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; neutral; abrupt, smooth boundary.

B21t—1½ to 4 inches, grayish-brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; common, fine, faint mottles of yellowish brown (10YR 5/6), dark yellowish brown (10YR 4/4) moist; moderate, medium, columnar structure parting to moderate, medium, and moderately fine angular blocky structure; very hard dry, firm moist, very sticky and very plastic wet; mildly alkaline; clear, wavy boundary.

B22t—4 to 13 inches, grayish-brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; common, fine, distinct mottles of yellowish brown (10YR 4/4); moderate, medium, prismatic structure parting to strong, fine, angular blocky structure; very hard dry, firm moist, very sticky and very plastic wet; moderately alkaline; wavy boundary.

B3—13 to 18 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak, medium and coarse, prismatic structure parting to moderate, medium, angular blocky structure; extremely hard dry, firm moist, very sticky and very plastic wet; strong effervescence; thread and modular segregation of gypsum crystals; moderately alkaline; wavy boundary.

C—18 to 60 inches, light olive-gray (5Y 6/2) clay, olive gray (5Y 4/2) moist; moderate, medium, angular blocky structure; extremely hard dry, firm, moist, very sticky and very plastic wet; strong effervescence; common prominent nodular segregations of gypsum crystals; strongly alkaline.

Depth to carbonates ranges from 10 to 34 inches. These soils commonly contain more than 45 percent clay to a depth of more than 30 inches. The A2 horizon is light-gray or light brownish-gray silty clay loam, silty clay, or clay. It ranges from neutral to moderately alkaline in reaction and from ½ to 4 inches in thickness. The B2t horizon is silty clay or clay and ranges from mildly alkaline to strongly alkaline. The structure of the B2t horizon is moderate or strong, and it is columnar in most places. In places accumulations of salts and gypsum are below the B horizon. The C horizon generally is silty clay or clay, but coarser textures are in places.

Heil soils are associated with the Absher, McKenzie, Rhoades, and Wolf Point soils. They are darker colored and finer textured than Absher soils, and they are darker colored than McKenzie soils. They are more poorly drained than Rhoades soils. Heil soils have a B horizon that is lacking in Wolf Point soils.

Korchea Series

This series consists of deep, moderately well drained and well drained soils. These soils range from level to gently sloping, but they are mainly level or nearly level. They are on bottom lands and terraces. These soils formed in alluvium.

In a representative profile the surface layer is dark grayish-brown loam about 6 inches thick. Below this is grayish-brown loam about 9 inches thick. The underlying material is grayish-brown, stratified alluvium of loam, silt loam, fine sandy loam, and very fine sandy loam, which average loam.

Permeability and organic-matter content are moderate. Available water capacity is high. Fertility is medium, and tilth is good.

The areas of Korchea soils are used for crops, hay, and pasture. The soils are suited to cultivated crops. They are suited to irrigation. The native vegetation consists mainly of green needlegrass, western wheatgrass, and blue grama.

Representative profile of Korchea loam, in native grass, 110 feet west and 790 feet south of the northeast corner of sec. 36, T. 129 N., R. 102 W.:

A1—0 to 6 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, coarse and medium, subangular blocky structure and moderate, fine, crumb structure; hard dry, very friable moist; many roots and fine pores; slight effervescence; moderately alkaline; clear, smooth boundary.

B2—6 to 15 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky structure; hard dry, friable moist; common roots and many fine pores; slight effervescence; moderately alkaline; abrupt boundary.

IIC1—15 to 18 inches, grayish-brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard dry, very friable moist; common roots; many fine pores; strong effervescence; moderately alkaline; abrupt boundary.

IIC2—18 to 36 inches, grayish-brown (2.5Y 5/2) strata of loam, silt loam, and very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive but parting to weak, coarse, subangular blocky structure and to coarse and fine, platy structure on strata lines; hard dry, friable moist; common roots decreasing to few at bottom of horizon; very few fine masses of lime in places in the layers; strong effervescence; moderately alkaline; clear, wavy boundary.

IIIC3—36 to 60 inches, grayish-brown (2.5Y 5/2) strata of fine sandy loam and loam, grayish-brown (2.5Y 4/2) moist; massive; slightly hard to hard dry, friable moist; few fine roots; strong effervescence; moderately alkaline.

Texture between depths of about 6 and 36 inches is stratified fine sandy loam, very fine sandy loam, loam, and silt loam. Some layers are noncalcareous, and some are mottled. Buried layers and gravel lenses or fragments are in some profiles. The A horizon is dark grayish-brown or grayish-brown loam, silt loam, or clay loam. It is mildly alkaline or moderately alkaline and is 4 to 10 inches thick. In places it is noncalcareous. The C horizon extends to a depth of about 24 inches and has weak to moderate prismatic or blocky structure or is massive.

Korchea soils are associated with Havre, Straw, Velva, and Wolf Point soils. They are darker colored than Havre soils and lack the thick, dark-colored solum of Straw soils.

They are finer textured than Velva soils but are coarser textured than Wolf Point soils.

Korchea loam (Kc).—This soil is on bottom lands and terraces. Slopes are mainly 1 to 3 percent but range from 0 to 6 percent. The relief is undulating in a few places where old stream channels cross the benches. Runoff in spring and seasonal storms sometimes flood this soil. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Korchea clay loam, wet variant, Korchea silt loam, Velva fine sandy loam, and claypan soils of the Belfield, Daglum, and Rhoades series.

Runoff is slow to medium, and the hazard of erosion is slight.

This soil is used for hay, crops, and pasture. It is suited to all crops commonly grown in the county. Most areas are suitable for irrigation or water spreading. This soil is well suited to trees. Although erosion is not a major hazard, measures to control soil blowing help to maintain organic-matter content and fertility. Capability unit IIc–6; Overflow range site; windbreak suitability group 1.

Korchea clay loam, wet variant (Ke).—This nearly level soil is in oxbows and other depressions on the alluvial flats along the major streams. The water table is near the surface or within a depth of 30 inches of the surface most of the year in most places. This soil is occasionally flooded, and water stands on the surface from a few days to a few weeks.

The profile of this Korchea soil is similar to that described as representative of the Korchea series, but the surface layer is clay loam that is underlain by stratified material that ranges from fine sandy loam to clay. In most places this soil is mottled throughout the profile because it is wet for long periods.

Included with this soil in mapping is a strip of poorly drained soils in the channel of Big Gumbo Creek in the western part of the county. Soils in this strip have a higher content of clay than those in most areas.

Unless this soil is drained, it is suited only to hay and pasture. Some areas have grass around the edges and wetland sedges or rushes in the wetter parts. Capability unit VIw–Ov; Overflow range site; windbreak suitability group 10.

Korchea-Havre complex (Kh).—The soils in this complex are on bottom lands and terraces. Most slopes are 0 to 3 percent, but about 190 acres have slopes of 3 to 6 percent. The relief is undulating in a few places where old stream channels cross the benches. This complex is about 60 percent Korchea loam, about 25 percent Havre loam and silt loam, and about 15 percent other soils. The dominant texture of the surface layer is loam.

The profile of Korchea soils is similar to that described as representative of the Korchea series, but the surface layer is thinner.

The profile of Havre soils is similar to that described as representative of the Havre series, except that in places the surface layer is silt loam.

Included with these soils in mapping are small areas of Kremlin loam, Korchea clay loam, wet variant, and Straw loam. Also included are 133 acres of Korchea clay loam, nearly level.

Runoff is slow to medium, and the hazard of erosion is slight.

The soils in this complex are used for hay, crops, and pasture. They are well suited to trees and are suited to all crops commonly grown in the county. Some areas are suitable for waterspreading and irrigation. Although erosion is not a major hazard, measures to control soil blowing help to maintain organic-matter content and fertility. Both soils in capability unit IIc–6; Overflow range site; windbreak suitability group 1.

Korchea-Straw complex (Km).—The soils in this complex are on bottom lands and terraces. Most slopes are 0 to 3 percent, but about 250 acres have slopes of 3 to 6 percent. The relief is undulating in a few places where old stream channels cross the benches. This complex is about 55 percent Korchea loam and silt loam, about 30 percent Straw loam and silt loam, and about 15 percent other soils. The dominant texture of the surface layer is loam.

The profile of Korchea soils is similar to that described as representative of the Korchea series, but the surface layer is thicker and in places is silt loam.

The profile of Straw soils is similar to that described as representative of the Straw series, except that in places the surface layer is silt loam.

Included with these soils in mapping are small areas of Daglum loam, Korchea clay loam, Korchea clay loam, wet variant, and Shambo loam.

Runoff is slow to medium, and the hazard of erosion is slight.

These soils are used for hay, crops, and pasture. They are well suited to trees and are suited to all crops commonly grown in the county. Some areas are suitable for water spreading and irrigation. Although erosion is not a major hazard, measures to control soil blowing help to maintain organic-matter content and fertility. Both soils in capability unit IIc–6; Overflow range site; windbreak suitability group 1.

Korchea and Havre soils, channeled (Kn).—The soils in this mapping unit are in channeled areas along smaller streams. Slopes range from 0 to 6 percent. The areas are uneven and are cut by channels that are steep sided and uncrossable by vehicles in most places. Some areas are part Korchea loam and silt loam and part Havre loam, silt loam, and clay loam, and other areas are entirely Korchea soils or entirely Havre soils. The soils in this unit are subject to seasonal flooding, but surface drainage is good.

The Korchea and Havre soils have profiles similar to the ones described as representative of their respective series, except that in places the surface layer is finer textured.

Included with these soils in mapping are areas of Chanta, Glendive, and Hanly soils. Also included are small areas of gullied land and terrace escarpments.

Most of the acreage of the soils in this unit is suited to crops, but the soils are difficult to cultivate because they are cut into small patches by stream channels. Streambank erosion and flooding are the main limitations to use of these soils. Because of these limitations, almost all the acreage of these soils is in native grasses. These soils are well suited to trees. Both soils in capability unit

VIe–Ov; Overflow range site; windbreak suitability group 1.

Korchea and Straw soils, channeled (Ko).—The soils in this mapping unit are in channeled areas along smaller streams. Slopes range from 0 to 6 percent. These areas are uneven and are divided into small patches by channels that are steep sided and uncrossable by vehicles in most places. Some areas are part Korchea loam and silt loam and part Straw loam and silt loam, and other areas are entirely Korchea soils or entirely Straw soils. The soils in this unit are subject to seasonal flooding, but surface drainage is good.

The profiles of Korchea and Straw soils are similar to the ones described as representative of their respective series, except that in places the surface layer is silt loam.

Included with these soils in mapping are areas of Parshall, Shambo, and Velva soils. Also included are a few small areas of gullied land and terrace escarpments.

Most of the acreage of the soils in this unit are suited to crops, but the soils are difficult to cultivate because the areas are cut into small patches by stream channels. Streambank erosion and flooding are the main limitations to use of these soils. Because of these limitations, almost all the acreage of these soils is in native grasses. These soils are well suited to trees. Capability unit VIe–Ov; Overflow range site; windbreak suitability group 1.

Kremlin Series

This series consists of deep, well-drained soils. These soils are nearly level to gently sloping, but are mainly nearly level. They are on toe slopes, fans, and terraces. These soils formed in alluvium.

In a representative profile the surface layer is grayish-brown loam about 7 inches thick. The friable, loamy subsoil, about 28 inches thick, is brown in the upper part and grayish brown in the middle and lower parts. The underlying material is light olive-brown fine sandy loam and loam.

Permeability and organic-matter content are moderate. Available water capacity is high and fertility is medium. Tilth is good.

These soils are used for crops, hay, and pasture. They are suited to cultivated crops, trees, and grass. They are suited to irrigation. The native vegetation is green needlegrass, western wheatgrass, and blue grama.

Representative profile of Kremlin loam, nearly level, in a cultivated field, 1,430 feet north and 100 feet west of the southeast corner of SW¼ sec. 12, T. 130 N., R. 106 W.:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure and weak, fine, crumb structure; hard dry, friable moist, slightly sticky and slightly plastic wet; many roots; many fine pores; neutral; abrupt, smooth boundary.

B21—7 to 13 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak, coarse and medium, prismatic structure parting to moderate, medium, angular blocky structure; hard dry, friable moist, slightly sticky and slightly plastic wet; common fine roots; many fine pores; mildly alkaline; clear, smooth boundary.

B22—13 to 24 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate, coarse and medium, prismatic structure parting to moderate, coarse and medium, prismatic structure; hard dry, friable moist, slightly sticky and slightly plastic wet; few roots; common fine pores; mildly alkaline; gradual boundary.

B23—24 to 35 inches, grayish-brown (2.5Y 5/2) loam, very dark grayish brown (2.5Y 3/2) moist; weak, coarse and medium, prismatic structure parting to moderate, medium, angular blocky structure; hard dry, friable moist; slightly sticky and slightly plastic wet; few fine roots; common fine pores; mildly alkaline; clear, wavy boundary.

IIC1—35 to 60 inches, light olive-brown (2.5Y 5/3) fine sandy loam and thin loam strata, olive brown (2.5Y 4/3) moist; weak, fine, subangular blocky structure; slightly hard dry, very friable moist; slight effervescence; few fine carbonates of lime on pebbles; mildly alkaline.

The solum ranges from 18 to 44 inches in thickness. Depth to lime ranges from 8 to 40 inches. Depth to bedrock in most places is more than 60 inches, but it is 40 to 60 inches in places. The A horizon is loam, silt loam, or clay loam. It is slightly acid or neutral and is 4 to 10 inches thick. The B horizon is loam, silt loam, or clay loam. The structure of this horizon is weak, moderate, or strong. The C horizon is loam, silt loam, or fine sandy loam, but it is clay loam in some places.

Kremlin soils are associated with Belfield, Boxwell, and Chanta soils. They are coarser textured than Belfield soils. They lack the sedimentary beds within a depth of 40 inches of Boxwell soils. They lack the distinct gravel and sand layer of Chanta soils.

Kremlin loam, nearly level (KrA).—This soil is on terraces. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Belfield loam, Chanta loam, and Toby fine sandy loam and loam.

Runoff is slow to moderate, and the hazard of erosion is slight.

Most areas of this soil are cultivated. A few scattered areas remain in grass. This soil is well suited to cultivated crops commonly grown in the county. Some areas are suitable for water spreading or irrigation. Capability unit IIc–6; Silty range site; windbreak suitability group 3.

Kremlin loam, gently sloping (KrB).—This soil is on fans and terraces. Slopes range from 3 to 9 percent. The profile of this soil is similar to that described as representative of the series, but it has a thinner surface layer and subsoil.

Included with this soil in mapping are small areas of Belfield loam, Chanta loam, and Toby fine sandy loam and loam.

Runoff generally is medium, but it is rapid where slopes are more than 6 percent. The hazard of erosion is slight to moderate. Controlling water erosion is the main need of management.

Most areas of this soil are cultivated, but some areas remain in grasses. This soil is suited to cultivated crops if good management practices are used. Some areas are suitable for water spreading or irrigation. Capability unit IIe–6; Silty range site; windbreak suitability group 3.

Kremlin-Belfield-Rhoades complex, nearly level (KsA).—The soils in this complex are on fans and terraces. Slopes are 0 to 6 percent, but only a few areas of these soils have slopes of greater than 6 percent. The complex is 55 to 80 percent Kremlin loam and silt loam, 20 to 40 percent Belfield loam and silt loam, 5 to 35 percent

Rhoades and Absher loams, 5 to 15 percent Daglum loam or silt loam, and 15 to 20 percent other soils. Most areas under a native grass cover have a pitted microrelief. The pitted areas, known locally as slick, scab, pan, or gumbo spots, support little or no vegetation and absorb water slowly. In most places the spots consist of Rhoades soils that have lost the material in the surface layer through erosion. In cultivated areas these spots are dispersed and puddled.

The profile of the Kremlin soils is similar to that described as representative of the Kremlin series, but it has a higher content of salt in the lower part of the subsoil and in the substratum. Also, in some places the surface layer is silt loam.

The profile of the Belfield and Rhoades soils are similar to the one described as representative of their respective series, but in places the surface layer of Belfield soils is loam.

Runoff is slow to medium. The hazard of erosion is slight to moderate. Controlling water erosion, improving tilth, conserving moisture, and maintaining organic-matter content and fertility are the main needs of managemen. Available water capacity is moderate to low where Daglum and Rhoades soils occur, and this hinders crop growth, especially during years of below-normal rainfall.

Much of this complex is cultivated. It is suited to most crops commonly grown in the county. If the Rhoades or Absher soils are cultivated, some crops, especially corn, emerge and grow slowly in the slick spots. All soils in capability unit IIIs–P; Kremlin part in Silty range site; windbreak suitability group 3. Belfield part in Clayey range site; windbreak suitability group 4. Rhoades part in Thin Claypan range site; windbreak suitability group 4.

Ladner Series

This series consists of deep, well-drained, gently sloping to rolling soils on fans, terraces, and uplands. These soils formed in alluvial material weathered from soft alkaline sandstone and soft, sandy shale.

In a representative profile the surface layer is light brownish-gray loamy fine sand about 6 inches thick. The subsoil, about 18 inches thick, is light brownish-gray, firm fine sandy loam in the upper part and light-gray, friable fine sandy loam in the lower part. The underlying material is light olive-gray fine sandy loam that has thin strata of loamy fine sand, very fine sand, and loam.

Permeability is slow. Available water capacity, organic-matter content, and fertility are low. The slowly permeable subsoil can be penetrated by only a few plant roots, most of which penetrate between the columns.

These soils are used for crops, hay, and pasture. Most areas are in native grasses. These soils are not suited to cultivated crops. Where they are cultivated, the surface layer is dispersed and puddled. They are not suited to trees. The native vegetation includes needle-and-thread, ble grama, sagebrush, and pricklypear.

Representative profile of a Ladner fine sandy loam in an area of Ekalaka-Zeona-Ladner loamy fine sands, gently sloping, in native grass, 33 feet north and 1,085 feet west of the southeast corner of NE¼ sec. 18, T. 129 N., R. 106 W.:

A2—0 to 6 inches, light brownish-gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure parting to weak, thin, platy structure; very friable moist; many roots in upper part; neutral; abrupt, smooth boundary.

B21t—6 to 8 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; strong, medium, columnar structure; extremely hard dry, firm moist, sticky wet; common roots along column sides; few fine pores; columns coated with clay films, very dark grayish brown (10YR 3/2) moist; strongly alkaline; clear, wavy boundary.

B22t—8 to 14 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, olive brown (2.5Y 4/3) moist; moderate, medium, prismatic structure parting to strong, medium, angular blocky structure; extremely hard dry, firm moist, sticky wet; few roots; few fine pores; thin clay films on prism faces, very dark grayish brown (2.5Y 3/2) moist; a few, small, white spots of lime; strongly alkaline; clear, wavy boundary.

B3—14 to 24 inches, light-gray (5Y 7/2) fine sandy loam, olive (5Y 5/3) moist; weak, coarse, prismatic structure parting to moderate, medium, angular blocky structure; very hard dry, friable moist; few fine roots; strongly alkaline; gradual, wavy boundary.

C—24 to 60 inches, light olive-gray (5Y 6/2) fine sandy loam, olive gray (5Y 5/2) moist; massive, but having thin strata of fine sandy loam, loamy fine sand, very fine sand, and loam; very hard dry; strong effervescence; strongly alkaline.

The solum ranges from 16 to 36 inches in thickness. Visible salts are between depths of 4 and 14 inches. Depth to sedimentary beds in most places ranges from 40 inches to more than 60 inches. The A2 horizon is light brownish-gray or grayish-brown fine sandy loam, loamy fine sand, or very fine sandy loam. An A1 horizon is in places. The individual thickness of the A horizon or of the A2 horizon or the combined thickness of these two horizons is less than 7 inches. The B horizon is light brownish gray, light yellowish brown, light gray, or gray. The structure of the B2t horizon is moderate or strong. The C horizon is loamy fine sand, fine sandy loam, or loam, and in places the material is mottled.

Ladner soils are associated with Absher, Daglum, Ekalaka, and Rhoades soils. They are coarser textured than Absher or Rhoades soils. They have a claypan subsoil at a shallower depth than Ekalaka soils. They are coarser textured than Daglum soils, and the thickness of the combined A1 and A2 horizons is less.

Lawther Series

This series consists of deep, moderately well drained, fine-textured, level to nearly level soils on fans and uplands. Slopes are mostly nearly level. These soils formed in alluvium and in material weathered from shale.

In a representative profile the surface layer is grayish-brown silty clay about 6 inches thick. The subsoil is about 28 inches thick. The upper part is firm silty clay that is grayish brown to a depth of about 11 inches and olive to a depth of about 21 inches; the lower part is very firm clay that is olive to a depth of about 29 inches and grayish brown to a depth of about 34 inches. The lower part contains crystals of gypsum. The underlying material, extending to a depth of 60 inches, is silty clay that contains crystals of gypsum and is olive gray when moist.

Permeability is slow, and available water capacity and fertility are high. Organic-matter content is moderate. These soils shrink and crack when dry and are highly susceptible to soil blowing. Tilth is fair to poor.

Most areas of these soils are cultivated. These soils are suited to most crops commonly grown in the county if good management practices are used. They are not so well suited to corn as coarser textured soils. The native vegetation includes green needlegrass, western wheatgrass, and blue grama. Some areas are suitable for water spreading or irrigation.

Representative profile of Lawther silty clay, in a cultivated field, 384 feet north and 286 feet west of the southeast corner of sec. 36, T. 131 N., R. 99 W.:

Ap—0 to 6 inches, grayish-brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; moderate, medium, angular blocky structure parting to strong, medium and fine, granular structure; firm moist, sticky and plastic wet; moderately alkaline; abrupt, smooth boundary.

B21—6 to 11 inches, grayish-brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak, medium, prismatic structure parting to moderate, medium, angular blocky structure; firm moist, sticky and plastic wet; slight effervescence; moderately alkaline; clear, wavy boundary.

B22—11 to 21 inches, olive (5Y 5/3) silty clay, olive (5Y 4/3) moist; moderate, medium, angular blocky structure; firm moist, sticky and plastic wet; strong effervescence; moderately alkaline; clear, wavy boundary.

B23—21 to 29 inches, olive (5Y 5/3) clay, olive (5Y 4/3) moist; weak, medium, prismatic structure parting to strong, medium, angular blocky structure; very firm moist, very sticky and very plastic wet; strong effervescence; moderately alkaline; clear, wavy boundary.

B3ca—29 to 34 inches, grayish-brown (2.5Y 5/3) clay, dark grayish brown (2.5Y 4/3) moist; weak, medium, prismatic structure parting to strong, medium, angular blocky structure; very firm moist, very sticky and very plastic wet; violent effervescence; few masses of lime; few crystals of gypsum; moderately alkaline; gradual, wavy boundary.

C1ca—34 to 42 inches, olive (5Y 4/3), moist, silty clay; moderate, medium, angular blocky structure; firm moist, plastic and sticky wet; violent effervescence; few masses of lime; moderately alkaline; gradual boundary.

C2cs—42 to 46 inches, olive-gray (5Y 4/2), moist, and very dark grayish-brown (2.5Y 3/2), moist, silty clay; firm moist, sticky and plastic wet; strong effervescence; few spots of lime; few crystals of gypsum; moderately alkaline; gradual boundary.

C3cs—46 to 60 inches, olive (5Y 5/3), moist, silty clay (auger); firm moist, sticky and plastic wet; strong effervescence; few spots of lime; common crystals of gypsum; moderately alkaline.

The solum ranges from 18 to 38 inches in thickness. Depth to carbonates ranges from 0 to 20 inches. Depth to sedimentary beds ranges from 40 inches to more than 60 inches, but in most places it is between 42 and 52 inches. The A horizon is grayish-brown or dark grayish-brown silty clay loam, silty clay, or clay. It is mildly alkaline or moderately alkaline and 4 to 10 inches thick. A weak crust forms on the surface in some places. The B horizon is grayish-brown, olive, olive-gray, or dark grayish-brown silty clay or clay. It ranges from mildly alkaline to strongly alkaline. The structure of this horizon is weak, moderate, or strong. In many places the peds have shiny faces when moist. The sedimentary beds of the C horizon are soft shale.

Lawther soils are associated with Grail, Moreau, and Regent soils. They have more clay than Grail soils. They are darker colored to a greater depth than Regent and Moreau soils, and they are deeper over sedimentary beds.

Lawther silty clay (La).—This soil is level or nearly level. It is on fans, terraces, and uplands. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Regent silty clay and silty clay loam, Rhoades silty clay loam, and Savage silty clay loam.

Runoff is slow to medium. After periods of heavy precipitation, the areas pond for a short time. Because the clods tend to slack and granulate in winter, soil blowing is a hazard before tillage in spring. Controlling soil blowing, improving tilth, and maintaining organic-matter content and fertility are the main needs of management.

Most of this soil is cultivated, but some areas are in grasses. This soil is suited to most crops commonly grown in the county if intensive management practices are used. It is poorly suited to corn, and very little corn is grown on this soil. Some areas are suitable for water spreading or irrigation. Capability unit IIs–4; Clayey range site; windbreak suitability group 4.

Lawther-Rhoades silty clays (Lc).—The soils in this complex are level and nearly level. They are in alluvium-filled basins on terraces along drainageways in uplands. The complex is 60 to 75 percent Lawther silty clay, 5 to 35 percent Rhoades silty clay, 15 to 20 percent Daglum silty clay, and 5 to 15 percent other soils. Some areas that are in native grasses have a pitted microrelief. The pitted areas, known locally as slick, scab, pan, or gumbo spots, support little or no vegetation and absorb water slowly. Under cultivation these spots are dispersed and puddled. In most places the spots are Rhoades soils that have lost the material in the surface layer through erosion.

The profile of the Lawther soils has a more dispersed surface layer and a higher content of salt in the lower part of the subsoil than the profile described as representative of the series.

The profile of the Rhoades soils is similar to that described as representative of the Rhoades series, but it has more clay.

Included with these soils in mapping are small areas of Belfield and Savage silty clay loams and Alluvial land, strongly saline.

Runoff is slow. After periods of heavy precipitation, water ponds on these soils for a short time. Because clods tend to slack and granulate in winter, soil blowing is a hazard before tillage in spring. Controlling soil blowing, improving tilth, conserving moisture, and maintaining organic-matter content and fertility are the main concerns of management. Available water capacity is moderate to low where Daglum and Rhoades soils occur, and this hinders crop growth, especially during years of below normal rainfall. There is considerable crusting after rains. Tilth is poor.

Most areas of these soils are cultivated, but some areas are in grasses. The soils are suited to most crops commonly grown in the county, but they are poorly suited to corn. Crops emerge and grow slowly in the dispersed areas. This complex is poorly suited to trees. Both soils in capability unit IIIs–P; Lawther part in Clayey range site; windbreak suitability group 4. Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Lefor Series

This series consists of moderately deep, well-drained, gently sloping to sloping soils that are moderately coarse textured to moderately fine textured. These soils are on uplands. They formed in sandy shale and sandstone.

In a representative profile the surface layer is brown fine sandy loam about 5 inches thick. The subsoil is friable, yellowish-brown sandy clay loam about 15 inches thick. The underlying material is light yellowish-brown fine sandy loam about 13 inches thick overlying soft sandstone sedimentary beds.

Permeability is moderate. Available water capacity is low to moderate, and organic-matter content is moderate. Fertility is medium, and tilth is fair. These soils are highly susceptible to soil blowing.

These soils are used for crops, hay, and pasture. They are suited to cultivated crops if good management practices are used. The native vegetation includes needle-and-thread, prairie sandreed, and threadleaf sedge.

Representative profile of Lefor fine sandy loam, gently sloping, in a cultivated field, 0.2 mile east and 164 feet south of the northwest corner of SW¼ sec. 35, T. 130 N., R. 102 W.:

Ap—0 to 5 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; cloddy to weak, fine, granular structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; slightly acid; abrupt boundary.

B2t—5 to 20 inches, yellowish-brown (10YR 5/4) sandy clay loam, dark brown (10YR 4/3) moist; moderate, coarse, prismatic structure; very hard dry, friable moist, sticky and slightly plastic wet; continuous, distinct, dark yellowish-brown (10YR 4/4) clay films on ped faces; neutral; clear, smooth boundary.

C1—20 to 33 inches, light yellowish-brown (2.5Y 6/3) fine sandy loam, olive brown (2.5Y 4/4) moist; weak, coarse, prismatic structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; violent effervescence; few nodules of segregated lime; mildly alkaline; clear boundary.

IIC2—33 to 60 inches, brownish-yellow (10YR 6/6) sedimentary beds with layer that crushes to loamy fine sand and fine sandy loam, yellowish brown (10YR 5/6) moist; hard dry, nonsticky and nonplastic wet; strong effervescence; moderately alkaline.

The solum ranges from 20 to 35 inches in thickness. In some places the soil is calcareous near the surface, but in others it is noncalcareous throughout. Depth to carbonates in most places ranges from 10 to 25 inches. Depth to sedimentary beds ranges from 30 to 40 inches, but in most places it is between 32 and 38 inches. The A horizon is brown or grayish-brown sandy loam or fine sandy loam. It is slightly acid or neutral and 4 to 10 inches thick. The B2t horizon is grayish-brown, brown, or yellowish-brown loam or sandy clay. The structure of the B2t horizon is moderate or strong. The sedimentary beds in the C horizon are sandy shale and sandstone.

Lefor soils are associated with Flasher, Tally, and Vebar soils. They have a B horizon that is lacking in Flasher soils. They have a finer textured subsoil than Tally or Vebar soils.

Lefor-Vebar fine sandy loams, gently sloping (LeB).—The soils in this complex are on uplands. Slopes range from 0 to 6 percent. The complex is about 60 percent Lefor fine sandy loam, 25 percent Vebar fine sandy loam, and 15 percent other soils. Lefor fine sandy loam has a finer textured subsoil than Vebar fine sandy loam.

Lefor soils have the profile described as representative of the Lefor series.

The profile of Vebar soils is similar to that described as representative of the Vebar series.

Included with these soils in maping are small areas of Arnegard loam, small areas of Flasher and Tally fine sandy loams, and a few scattered areas where the soils are moderately eroded.

Runoff is medium on the soils in this unit. The soils are highly susceptible to soil blowing and moderately susceptible to water erosion where slopes are 4 to 6 percent. Controlling soil blowing and maintaining organic-matter content and fertility are the main needs of management.

Most areas of these soils are cultivated; but some areas are in grasses. The soils are suited to cultivated crops commonly grown in the county if good management practices are used. Both soils in capability unit IIIe–3M; Sandy range site; windbreak suitability group 5.

Lefor-Vebar fine sandy loams, sloping (LeC).—The soils in this complex are on uplands. Slopes range from 6 to 9 percent. The complex is about 55 percent Lefor fine sandy loam, 30 percent Vebar fine sandy loam, and 15 percent other soils. Lefor soils have a finer textured subsoil than Vebar soils.

The profiles of the Lefor and Vebar soils are similar to the ones described as representative of their respective series, but the surface layer and subsoil are thinner.

Included with these soils in mapping are small areas of Arnegard loam, Flasher and Tally fine sandy loams, and a few scattered areas where soils are moderately eroded.

Runoff is medium. These soils are highly susceptible to soil blowing and moderately susceptible to water erosion. Controlling soil blowing and water erosion and maintaining organic-matter content and fertility are the main needs of management.

Some areas of these soils are cultivated. Other areas are in grasses. These soils are suited to limited cultivation if good management practices are used. Both soils in capability unit IVe–3; Sandy range site; windbreak suitability group 5.

Lehr Series

This series consists of well-drained and excessively drained, level to sloping soils on fans and terraces. These soils are shallow to sand and gravel. They formed in alluvium.

In a representative profile the surface layer is dark grayish-brown loam about 6 inches thick. The friable subsoil is brown loam about 7 inches thick. The underlying material is light brownish-gray gravelly loam about 5 inches thick over sand and gravel.

Permeability is moderately rapid above the gravel substratum and very rapid below. Available water capacity is low, and organic-matter content is moderate. Fertility is medium.

These soils are used for crops, hay, and pasture. They are suited to cultivation if good management practices are used. They are not suited to trees. The native vegeta-

tion includes green needlegrass, western wheatgrass, and blue grama.

Representative profile of a Lehr loam, in an area of Lehr, Manning, and Wabek soils, sloping, in a cultivated field, 105 feet west and 924 feet north of the southeast corner of NE¼ sec. 9, T. 132 N., R. 100 W.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure parting to weak, medium, crumb structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; neutral; abrupt, smooth boundary.

B2—6 to 13 inches, brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; weak, medium and coarse, prismatic structure parting to weak, medium, subangular blocky structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; neutral; clear boundary.

Cca—13 to 18 inches, light brownish-gray (2.5Y 5/2) gravelly loam, moist; weak, medium, subangular blocky structure; hard dry, friable moist, slightly sticky and nonplastic wet; violent effervescence; pebbles crusted with lime; moderately alkaline; clear boundary.

IIC—18 to 60 inches, light brownish-gray (2.5Y 6/2) sand and gravel containing some fines, grayish brown (2.5Y 5/2) moist; single grain; loose dry, nonsticky and nonplastic wet; slight effervescence; moderately alkaline; some pebbles crusted with lime.

The thickness of the solum, depth to carbonates, and depth to the gravel or sand range from 10 to 20 inches. In some places pebbles are throughout the profile. The A horizon is grayish-brown or dark grayish-brown fine sandy loam, loam, or silt loam. It is neutral or mildly alkaline and is 4 to 8 inches thick. The B2 horizon is brown, grayish-brown, or light brownish-gray loam or clay loam. The structure of the B horizon is weak or moderate. The Cca horizon is indistinct, and in some places it is lacking. The IIC horizon is gravel, coarse sand, loamy gravel, or a mixture of these materials.

Lehr soils are associated with Manning, Stady, and Wabek soils. They have finer textured A and B horizons overlying gravel and sand than Manning soils. They are shallower to gravel and sand than Stady soils and deeper over gravel and sand than Wabek soils.

Lehr, Manning, and Wabek soils, sloping (LmC).—The soils in this mapping unit are on terrace edges and the more sloping parts of high terraces. Slopes are 6 to 9 percent. Some areas of this unit are Lehr, Manning, or Wabek soils. Other areas are a combination of any two or of all of these soils.

Lehr soils have the profile described as representative of the series.

The profiles of the Manning and Wabek soils are similar to the ones described as representative of their respective series.

Runoff is medium, and the hazard of water erosion is moderate to severe. Available water capacity is low to very low.

Most of the acreage of these soils is cultivated. The soils are suited to cultivation if intensive management practices are used. Controlling water erosion is a main concern of management. All soils in capability unit IVes-3; Lehr part in Shallow to Gravel range site; windbreak suitability group 6. Manning part in Sandy range site; windbreak suitability group 6. Wabek part in Very Shallow range site; windbreak suitability group 10.

Lisam Series

This series consists of shallow, well-drained, fine-textured, rolling to steep soils on uplands. These soils formed in material weathered from shale.

In a representative profile the surface layer is grayish-brown clay about 3 inches thick. Below this layer is firm light brownish-gray clay about 6 inches thick. The underlying material is light olive-gray clay about 6 inches thick over clayey shale sedimentary beds.

Permeability is slow. Available water capacity, organic-matter content, and fertility are low.

These soils are used for pasture and as wildlife habitat. Rocky Mountain juniper and a few pines are in places. These soils are not suited to cultivation. A large part of the surface is bare, but in vegetated areas the native species include various sages, rabbit brush, spike wheatgrass, western wheatgrass, false lupine, and annual weeds.

Representative profile of Lisam clay in an area of Dilts and Lisam clays, rolling, in native grass, 755 feet west of State Route 16 and 180 feet south of a gasoline pumphouse, NE¼NE¼ sec. 6, T. 129 N., R. 106 W.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, medium, subangular blocky structure parting to strong, fine, granular structure; very hard dry, firm moist, sticky and very plastic wet; common very fine and fine roots; slight effervescence; moderately alkaline; clear, wavy boundary.

C1—3 to 9 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, coarse and moderate, medium, subangular blocky structure; extremely hard dry, firm moist, sticky and very plastic wet; few fine and medium roots; common fine pores; many fine crystals of gypsum; few platy fragments of shale; slight effervescence; moderately alkaline; clear, wavy boundary.

C2—9 to 15 inches, light olive-gray (5Y 6/2) clay and partly weathered, platy mudstone, olive gray (5Y 5/2) moist; weak, coarse and fine, subangular blocky structure parting to fine, platy structure; extremely hard dry, firm moist, sticky and plastic wet; few very fine roots; common fine crystals of gypsum; slight effervescence; moderately alkaline; gradual, wavy boundary.

C3—15 to 60 inches, light olive-gray (5Y 6/2) platy shale, olive gray (5Y 5/2) platy shale, olive gray (5Y 5/2) moist; rubs to a clay texture; light olive-brown and yellowish-brown stains (2.5Y 5/6 and 10YR 5/6) on some plate surfaces; thin gypsum crystals and sheets in the shale; moderately alkaline.

Depth to shale ranges from 10 to 20 inches. The A horizon is dark grayish-brown, grayish-brown, or olive-gray silty clay or clay. It ranges from neutral to moderately alkaline. The sedimentary beds in the C horizon are shale that has a crushed texture of silty clay and clay. In places this horizon has brown and reddish mottles. Partly weathered shale is at a depth of 4 to 10 inches in a few places.

Lisam soils are associated with Dilts soils. They are alkaline, but Dilts soils are acid. They have more clay in their profile than Yawdim soils, and their C horizon is denser.

Manning Series

This series consists of well-drained and somewhat excessively drained, nearly level to sloping soils on fans and terraces. These soils are moderately deep over gravel or sand. They formed in alluvium.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 13 inches thick. The very friable subsoil is grayish-brown fine sandy loam about 12 inches thick. The underlying material is grayish-brown gravelly fine sand to a depth of about 37 inches and dark grayish-brown gravelly sand below to a depth of 60 inches.

Permeability is moderately rapid in the subsoil and rapid or very rapid in the underlying material. Available water capacity is low. Organic-matter content is moderate, and fertility is medium. Tilth is good.

These soils are used for crops and pasture. Needle-and-thread, prairie sandreed, and threadleaf sedge are the main species on range. These soils are suited to cultivated crops.

Representative profile of Manning fine sandy loam, nearly level, in a cultivated field, 120 feet west and 100 feet north of the southeast corner of sec. 21, T. 131 N., R. 100 W.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; soft dry, very friable moist, nonsticky and nonplastic wet; neutral; abrupt, smooth boundary.

A1—6 to 13 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky structure; very friable moist, nonsticky and nonplastic wet; neutral; gradual, wavy boundary.

B2—13 to 22 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky structure; very friable moist, nonsticky and nonplastic wet; mildly alkaline; gradual, wavy boundary.

B3Ca—22 to 25 inches, grayish-brown (2.5Y 5/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky structure; friable moist, nonsticky and slightly plastic wet; violent effervescence; few segregations of lime; moderately alkaline; irregular boundary.

IICca—25 to 29 inches, grayish-brown (2.5Y 5/2) gravelly fine sand, dark grayish brown (2.5Y 4/2) moist; massive; nonsticky and nonplastic wet; violent effervescence; pebbles coated with lime; moderately alkaline; irregular boundary.

IIC2—29 to 37 inches, grayish-brown (2.5Y 5/2) gravelly fine sand, dark grayish brown (2.5Y 4/2) moist; single grain; nonsticky and nonplastic wet; strong effervescence; pebbles coated with lime; strongly alkaline; irregular boundary.

IIC3—37 to 60 inches, dark grayish-brown (2.5Y 4/2) gravelly sand, moist; single grain; slight effervescence; pebbles coated with lime; strongly alkaline.

The solum ranges from 16 to 32 inches in thickness. Depth to carbonates ranges from 15 to 25 inches. Depth to gravel or sand ranges from 20 to 40 inches but is between depths of 20 and 30 inches in most places. The A horizon is grayish-brown or dark grayish-brown sandy loam or fine sandy loam. It ranges from 4 to 15 inches in thickness and is slightly acid or neutral. The B horizon is brown, grayish-brown, or dark grayish-brown sandy loam or fine sandy loam. Its structure is weak, moderate, or strong. The Cca horizon is lacking in some places. The C horizon is gravel, loamy gravel, or gravelly fine sand.

Manning soils are associated with Lehr, Stady, and Wabek soils. They are deeper over gravel and sand than Lehr and Wabek soils. They are finer textured above the gravel and sand than Lehr and Stady soils.

Manning fine sandy loam, nearly level (MoA).—This This soil is on terraces and terrace fans. In places pebbles are on the surface. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Parshall and Tally fine sandy loams, Stady loam, and Wabek fine sandy loam.

Runoff is slow. Most of the rainfall is absorbed by the soil. This soil is highly susceptible to soil blowing.

Most areas of this soil are cultivated, but some areas remain in grasses. A few areas have been mined for gravel. This soil is suited to cultivation if good management practices are used. Capability unit IIIes–3; Sandy range site; windbreak suitability group 6.

Manning fine sandy loam, gently sloping (MoB).—This soil is on terraces and fans. Slopes are 3 to 6 percent. In places numerous pebbles are on the surface. The profile of this soil is similar to that described as representative of the series, but the surface layer is thinner.

Included with this soil in mapping are small areas of Lehr and Stady loams, Talley fine sandy loam, and Wabek fine sandy loam.

Runoff is slow. Most of the rainfall is absorbed by the soil. Soil blowing is the main hazard, and the low available water capacity is the main limitation.

Many areas of this soil are cultivated, but some areas remain in grasses. This soil is suited to cultivation if intensive management practices are used. Capability unit IIIes–3; Sandy range site; windbreak suitability group 6.

Marmarth Series

This series consists of moderately deep, well-drained, medium-textured, nearly level to sloping soils on uplands. These soils formed in material weathered from soft shale and fine-grained sandstone.

In a representative profile the surface layer is grayish-brown loam about 7 inches thick. The friable subsoil, about 18 inches thick, is brown clay loam in the upper part, light olive-brown clay loam in the middle part, and light yellowish-brown loam in the lower part. Below is light brownish-gray loam about 10 inches thick that is underlain by very soft, fine-grained sedimentary beds of sandstone.

Permeability, available water capacity, and organic-matter content are moderate. Fertility is medium. Tilth is good.

Most areas of these soils are used for crops, but some areas remain in native grasses, mainly green needlegrass, blue grama, western wheatgrass, and needle-and-thread. These soils are suited to cultivated crops and grasses commonly grown in the county.

Representative profile of Marmarth loam, gently sloping, in a cultivated field, 1,155 feet west and 160 feet south of the northeast corner of sec. 19, T. 131 N., R. 106 W.:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure parting to moderate, fine, crumb structure; hard dry, friable moist,

slightly sticky wet; many roots and pores; neutral; abrupt, smooth boundary.

B21t—7 to 12 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; strong, medium, prismatic structure parting to strong, medium, angular blocky structure; hard dry, friable moist, sticky and plastic wet; common roots; common fine pores; thin films of dark-brown (10YR 3/3) clay, moist; neutral; clear, wavy boundary.

B22t—12 to 19 inches, light olive-brown (2.5Y 5/3), crushed, clay loam (10YR 5/3), uncrushed), olive (2.5Y 4/3) moist; moderate, medium, prismatic structure parting to moderate, medium, angular blocky structure; hard dry, friable moist, sticky and plastic wet; few roots; common fine pores; neutral; clear, wavy boundary.

B3ca—19 to 25 inches, light yellowish-brown (2.5Y 6/3) loam, olive brown (2.5Y 4/3) moist; moderate, medium, prismatic structure parting to moderate, medium, angular blocky structure; hard dry, friable moist, sticky and plastic wet; few roots; few medium pores; common masses of soft lime; violent effervescence; moderately alkaline; clear, wavy boundary.

Cca—25 to 35 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; very weak, coarse, subangular blocky structure; hard dry, friable moist, slightly sticky wet; few fine roots; few pores; few fine masses of white lime; strong effervescence; moderately alkaline; clear, wavy boundary.

C2—35 to 60 inches, pale-yellow (2.5Y 7/4 and 6/4) very soft, stratified, moderately effervescent, fine-grained sandstone, olive (5Y 5/3) moist.

The solum ranges from 16 to 32 inches in thickness. Depth to carbonates ranges from 15 to 25 inches. Some profiles are noncalcareous. Depth to bedrock ranges from 20 to 40 inches but in most places is between 28 and 38 inches. The A horizon is grayish-brown loam, clay loam, fine sandy loam, very fine sandy loam, or silt loam. It is slightly acid or neutral and is 4 to 9 inches thick. The B2t horizon is light brownish-gray, grayish-brown, brown, light olive-brown, or light yellowish-brown loam or clay loam. It ranges from neutral to moderately alkaline. The structure of the B horizon is moderate or strong. The sedimentary beds in the C horizon are soft shale and sandstone.

Marmarth soils are associated with Boxwell, Cabbart, and Rhame soils. They have a finer textured B horizon than Boxwell soils. They have a thicker solum than Cabbart soils and are finer textured than Rhame soils.

Marmarth loam, gently sloping (MeB).—This soil is on uplands. Slopes range from 0 to 6 percent but are mainly 3 to 6 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Boxwell and Cabbart loams, Marmarth loam, moderately eroded, and Chama and Morton silty clay loams, gently sloping. Also included are some areas of Kremlin loam in concave positions on the landscape.

Runoff is medium, and the hazard of water erosion is slight to moderate. Controlling water erosion, conserving moisture, and maintaining fertility are the main needs of management.

Most areas of this soil are cultivated, but some areas remain in grasses. This soil is suited to cultivated crops if good management practices are used. Capability unit IIIe–6; Silty range site; windbreak suitability group 3.

Marmarth-Cabbart complex, sloping (MgC).—The soils in this complex are on uplands. Slopes are 6 to 9 percent. The complex is about 65 percent Marmarth loam and silt loam, 20 percent Cabbart loam and silt loam, and 15 percent other soils. Marmarth soils have a thicker solum than Cabbart soils. They are in the low and middle positions on the landscape, whereas Cabbart soils are in convex higher positions.

The profile of the Marmarth soils is similar to that described as representative of the Marmarth series, but the surface layer and subsoil are thinner.

The profile of the Cabbart soils is similar to that described as representative of the Cabbart series, but it has a thicker surface layer and subsoil that in places are loam.

Included with these soils in mapping are small areas of Boxwell and Kremlin loams, moderately eroded Marmarth and Cabbart loams, and Rhoades soils. Also included are 156 acres of Chama, Morton, and Cabba silty clay loams, sloping, and 35 acres of these soils that are strongly sloping.

Runoff is medium, and the hazard of water erosion is moderate. Controlling water erosion, conserving moisture, and maintaining fertility are the main needs of management.

Many areas of these soils are cultivated. Other areas remain in grasses. The soils are suited to cultivated crops if good management practices are used. Both soils in capability unit IVe–6; Marmarth part in Silty range site; windbreak suitability group 3; Cabbart part in Shallow range site; windbreak suitability group 8.

Marmarth-Rhame fine sandy loams, gently sloping (MhB).—The soils in this complex are on uplands. Slopes range from 0 to 6 percent but are mainly 3 to 6 percent. The complex is about 60 percent Marmarth fine sandy loam, 25 percent Rhame fine sandy loam, and 15 percent other soils.

The profile of the Marmarth soils is similar to that described as representative of the Marmarth series, but the surface layer is fine sandy loam.

The profile of the Rhame soils is similar to that described as representative of the Rhame series.

Included with these soils in mapping are small areas of Fleak and Tusler fine sandy loams. Toby fine sandy loam, and small areas of moderately eroded soils.

Runoff is slow where slopes are less than 3 percent and medium where slopes are 3 to 6 percent. Intense rainstorms have caused water erosion in places where slopes are 3 to 6 percent. These soils are highly susceptible to soil blowing. Controlling soil blowing, conserving moisture, and maintaining fertility are the main needs of management.

Most areas of these soils are cultivated, but some areas remain in grasses. The soils are suited to cultivated crops if good management practices are used. Both soils in capability unit IIIe–3M; Marmarth part in Silty range site; windbreak suitability group 3; Rhame part in Sandy range site; windbreak suitability group 5.

Marmarth-Rhame fine sandy loams, sloping (MhC).—The soils in this complex are on uplands. Slopes are 6 to 9 percent. The complex is about 55 percent Marmarth loam, 25 percent Rhame fine sandy loam, and 20 percent other soils. Marmarth soils have a finer textured subsoil than Rhame soils.

The profile of Marmarth soils is similar to that described as representative of the Marmarth series, but the surface layer is fine sandy loam.

The profile of Rhame soils is similar to that described as representative of the Rhame series, but the surface layer and subsoil are thinner.

Included with these soils in mapping are small areas of Fleak and Tusler fine sandy loams and of moderately eroded soils.

Runoff is medium. In places these soils are susceptible to water erosion caused by intense rainstorms. These soils are highly susceptible to soil blowing. Controlling soil blowing and water erosion and maintaining fertility and conserving moisture are the main needs of management.

Some areas of these soils are cultivated. Other areas remain in grasses. The soils are suited to cultivated crops if good management practices are used. Both soils in capability unit IVe–3; Marmarth part in Silty range site; windbreak suitability group 3; Rhame part in Sandy Range site; windbreak suitability group 5.

Marmarth-Rhoades complex, nearly level (MkA).—In this complex are soils on uplands. The complex is 60 to 85 percent Marmarth and Boxwell loams and silt loams, 5 to 35 percent Rhoades or Absher silt loams, 5 to 25 percent Daglum and Belfield soils, and 5 to 15 percent other soils. In places, areas in grass have a pitted microrelief. The pitted areas, locally known as slick, scab, pan, or gumbo spots, support little or no vegetation and absorb water slowly. Under cultivation these spots are dispersed and puddled. In most places the spots are Rhoades or Absher soils that have lost material in the surface layer through erosion.

The profile of the Marmarth soils is similar to the one described as representative of the Marmarth series, but the content of salt in the lower part of the subsoil is higher.

The profile of the Rhoades soils is similar to that described as representative of the Rhoades series, but the surface layer is silt loam.

Included with these soils in mapping are small areas of Moreau silty clay loam and Ekalaka fine sandy loam.

Runoff is slow. Available water capacity is moderate to low where the Rhoades and Daglum soils occur, and this hinders crop growth, especially during years of below-normal rainfall. Conserving moisture, improving tilth, and maintaining organic-matter content are the main needs of management.

Many areas of these soils are cultivated. Other areas remain in grasses. The soils are suited to most crops commonly grown in the county. Where Rhoades soils are cultivated along with the nearby Absher soils in dispersed areas, some crops, especially corn, emerge and grow slowly. Both soils in capability unit IIIs–P; Marmarth part in Silty range site; windbreak suitability group 3. Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Marmarth-Rhoades complex, gently sloping (MkB).—The soils in this complex are on uplands. Slopes are 3 to 6 percent. The complex is 60 to 80 percent Marmarth and Boxwell loam and silt loam, 5 to 35 percent Rhoades soil, 15 to 30 percent Daglum and Belfield loam and silt loam, and 5 to 15 percent other soils. In places areas in native grass have a pitted microrelief. The pitted areas are locally known as slick, scab, pan, or gumbo spots. These spots support little or no vegetation and absorb water slowly. In cultivated areas these spots are dispersed and puddled. In most places the spots are Rhoades or Absher soils that have lost the material in the surface layer through erosion.

Marmarth soils have a profile similar to that described as representative of the Marmarth series, but they have a higher content of salt in the lower part of the subsoil.

Rhoades soils have a profile similar to that described as representative of the Rhoades series.

Included with these soils in mapping are small areas of Cabba loam and silt loam, Moreau silty clay loam, and Grail soils, saline. Also included is 190 acres of soils that are moderately eroded.

Runoff is medium. The hazard of water erosion is moderate. Controlling water erosion is a necessary part of good management. Available water capacity is moderate to low where the Daglum and Rhoades soils occur. Crops are severely damaged during years of below-normal rainfall. Good management practices include improving tilth, conserving moisture, and maintaining organic-matter content and fertility.

Many areas of these soils are cultivated. Other areas remain in grass. These soils are suited to most crops common to the county. Some crops, especially corn, emerge and develop slowly where Rhoades soils are cultivated along with nearby Absher soils in dispersed areas. Both soils in capability unit IIIe–P; Marmarth part in Silty range site; windbreak suitability group 3. Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Marmarth-Rhoades complex, sloping (MkC).—The soils in this complex are on uplands. Slopes are 6 to 9 percent. The complex is 50 to 70 percent Marmarth and Boxwell loams, 15 to 30 percent Rhoades and Absher soils, and 5 to 15 percent other soils. In areas in native grass, the microrelief is pitted in places. The pitted areas are locally known as slick, scab, pan, or gumbo spots. These spots support little or no vegetation and absorb water slowly. In most places the spots are Rhoades or Absher soils that have lost the material in the surface layer through erosion.

Marmarth soils have a profile similar to that described as representative of the Marmarth series, but they have a higher content of salt in the lower part of the subsoil.

Rhoades soils have a profile similar to that described as representative of the Rhoades series.

Included with these soils in mapping are a few small areas of Marmarth-Rhoades soils that are steeper. Also included are small areas of Cabbart silt loam, Moreau silty clay loam, and Grail soils, saline.

Runoff is medium to rapid. The hazard of water erosion is severe. Available water capacity is moderate to low where the Daglum and Absher-Rhoades soils occur, and crops are severely damaged during years of below-normal rainfall. Controlling water erosion, improving tilth, conserving moisture, and maintaining organic-matter content and fertility are needs of management.

Much of the acreage of these soils is cultivated. These soils are suited to cultivation if good management practices are used. Some crops, especially corn, emerge and develop slowly where Rhoades soils are cultivated along with Absher soils in dispersed areas. Both soils in capability unit IVe–P; Marmarth part in Silty range site;

windbreak suitability group 3. Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Marmarth and Boxwell very stony loams (Mm).—The soils in this mapping unit are on uplands. Slopes are 0 to 9 percent but are mainly 3 to 6 percent. Tillage is not practical, because numerous stones are on the surface and in the soil. The stones range from 5 to 48 inches in length. Some areas are part Marmarth loam and silt loam and part Boxwell loam and silt loam, and others are entirely Marmarth soils or entirely Boxwell soils.

Included with these soils in mapping are small areas of Cabba loam, Morton silty clay loam, and Rhoades loam.

Runoff is slow on the nearly level soils in this mapping unit and medium on the sloping and gently sloping soils. The need of management is to control grazing.

These soils are in native grasses and are used for grazing. Some areas have potential for use as wildlife habitat. Stones are accessible in most places and are used as construction material for dams and roads. Both soils in capability unit VIIs–Si; Silty range site; windbreak suitability group 10.

McKenzie Series

This series consists of deep, poorly drained, fine-textured, level and nearly level soils in undrained basins and depressions. These soils formed in material washed into these areas.

In a representative profile the surface layer is light-gray silty clay loam about 1 inch thick. The very firm subsoil is about 13 inches thick. It is light-gray silty clay and clay in the upper part and light-brownish-gray silty clay in the lower part. The underlying material is light brownish-gray silty clay and clay about 20 inches thick over pale-brown and very pale brown sandy clay and light olive-brown, grayish-brown, and light yellowish-brown sandy clay loam.

Permeability is very slow. Available water capacity and organic-matter content are moderate. Fertility is medium.

These soils are suited to and used for pasture or hay. The soils mainly support a very sparse cover of western wheatgrass and wetland sedge. They are not suited to trees.

Representative profile of a McKenzie silty clay loam, in a closed basin, 60 feet north and 1,452 feet west of the southeast corner of NE¼ sec. 7, T. 131 N., R. 101 W.:

A1—0 to 1 inch, light-gray (2.5Y 6/1) silty clay loam, gray (10YR 5/1) moist; massive; very hard dry, firm moist, sticky and plastic wet; strongly alkaline; abrupt, smooth boundary.

B21—1 to 4 inches, light-gray (2.5Y 6/1) silty clay, dark gray (2.5Y 4/1) moist; weak, medium and fine, subangular blocky structure; extremely hard dry, very firm moist, very sticky and very plastic wet; strongly alkaline; clear, smooth boundary.

B22—4 to 8 inches, light-gray (2.5Y 6/1) clay, dark gray (2.5Y 4/1) moist; moderate, medium and fine, subangular blocky structure; extremely hard dry, very firm moist, very sticky and very plastic wet; strongly alkaline; clear, wavy boundary.

B23—8 to 14 inches, light brownish-gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate, medium, subangular blocky structure; extremely hard dry, very firm moist, very sticky and very plastic wet; strong effervescence; strongly alkaline; gradual, wavy boundary.

C1—14 to 17 inches, light brownish-gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; hard dry, very firm moist, very sticky and very plastic wet; strong effervescence; strongly alkaline; gradual, wavy boundary.

C2—17 to 34 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) moist; mottles of olive brown (2.5Y 4/3) and yellowish brown (10YR 5/6) moist; massive; very hard dry, very firm moist, very sticky and very plastic wet; strong effervescence; few crystals of gypsum; strongly alkaline; gradual, wavy boundary.

11C3—34 to 41 inches, pale-brown and very pale brown (2.5Y 6/3 and 7/3) sandy clay, grayish brown, light olive brown, and light yellowish brown (2.5Y 5/2, 5/3 and 6/3) moist; mottles of yellowish brown (10YR 5/8) moist; massive; very hard dry, very firm moist, very plastic and very sticky wet; violent effervescence; many crystals of gypsum; strongly alkaline; gradual, smooth boundary.

IIC4–41 to 60 inches, grayish-brown, light olive-brown, and light yellowish-brown (2.5Y 5/2, 5/3, and 6/3) moist, clay loam; mottles of yellowish brown (10YR 5/8) moist; massive; sticky and plastic; violent effervescence; strongly alkaline.

The content of clay is more than 45 percent to a depth of more than 30 inches. Depth to carbonates ranges from 10 to 34 inches. Mottles range from none to many throughout. The A1 horizon is light-gray and light grayish-brown silty clay loam, clay loam, silty clay, or clay. It ranges from neutral to strongly alkaline and is ½ to 2 inches thick. The layers from a depth of 10 to 40 inches are sandy clay, silty clay, or clay. They range from mildly alkaline to strongly alkaline. They are massive or have weak, moderate, or strong structure. The C horizon, below a depth of 40 inches, is sandy clay, clay, silty clay, or clay loam.

McKenzie soils are associated with Heil soils. They are more massive and lack the columnar B2t horizon of Heil soils.

McKenzie silty clay (Mn).—This level and nearly level soil is in clay-filled basins and depressions on uplands. It has the profile described as representative of the series. Vegetation is mainly sparse stands of western wheatgrass, and in the lower part of the basins it is mainly slough grass, wetland sedges, and Indian tobacco grass. During dry periods some wild barley grows in the lower areas.

Included with this soil in mapping are small areas of Heil silty clay and Absher and Rhoades silty clay loams.

There is no surface drainage. This soil is seasonally flooded and is wetter than McKenzie and Heil silty clays.

This soil is used mainly for grazing. Only a few areas are used for hay. This soil is not suited to cultivation, but it is suited to grass. Some areas provide good sites for dugouts. Capability unit VIs–CD; Closed Depression range site; windbreak suitability group 10.

McKenzie and Heil silty clays (Mo).—The soils in this unit are level and are in clay-filled basins on uplands and on a few flood plains where drainage is poor. Some areas are all McKenzie silty clay and some are all Heil silty clay. Other areas are Heil soils on the higher parts of the depressions and McKenzie soils on the lower part. These soils have a mottled subsoil.

McKenzie silty clay has a profile similar to that described as representative of the McKenzie series.

Heil silty clay has the profile described as representative of the Heil series.

Included in mapping are small areas of Absher and Rhoades silty clay loams.

These soils are seasonally flooded. There is no surface drainage. The outer edges of the basins are the driest, and the central parts are wet for longer periods. Some areas have dense stands of western wheatgrass, and others have sparse vegetation.

These soils are used for crops, hay, and pasture. Most of the McKenzie soils are used for grazing. McKenzie soils are not suited to cultivation. Heil soils are poorly suited to cultivation. Proper drainage is necessary before cultivation is practical. Tilth is difficult to maintain. Tillage must be done at proper moisture content. Cultivated areas are used for wheat, oats, barley, and alfalfa. In places salts in the subsoil and in the substratum further limit crop growth. These soils are not suited to corn. They are better suited to grasses than to most other uses. Some areas provide good sites for dugouts. McKenzie part in capability unit VIs–CD; Closed Depression range site; windbreak suitability group 10. Heil part in capability unit IVs–w; Closed Depression range site; windbreak suitability group 10.

Mine Dumps

Mine dumps (Mp) consist of areas that have been strip mined. These areas are mainly coal-pits and the associated piles of waste. Reaction ranges from strongly acid to moderately alkaline in exposed areas. Some areas are still mined, and others have been abandoned for years.

Included with this land type in mapping are some areas of mine sinkholes caused by underground mining of coal. Also included are city dump grounds where pits or trenches are used to discard refuse and debris.

Some areas of this land type are used for grazing. Others are idle. Grazing is limited because of steepness, irregular slopes, sinkholes, and sparse vegetation on the piles of eroding waste. Some areas could be reclaimed and revegetated for use as range. Sweetclover and weeds are between the piles of waste material in places. Capability unit VIIIs; range site not assigned; windbreak suitability group 10.

Moreau Series

This series consists of moderately deep, well-drained, fine-textured, nearly level to sloping soils on uplands. Scattered stones are on the surface in a few places. These soils formed in shale.

In a representative profile the surface layer is grayish-brown silty clay about 5 inches thick. The subsoil is firm silty clay about 17 inches thick. It is light brownish gray in the upper part, light gray to gray in the middle part, and light gray to gray and olive gray in the lower part. Below this is soft shale and siltstone that are partly weathered in the upper part.

Permeability is slow. Available water capacity and organic-matter content are moderate. Fertility is medium. Moreau soils shrink and crack when dry. These soils are highly susceptible to soil blowing and are susceptible to water erosion where slope is more than 3 percent. Tilth is poor.

These soils are used for crops, hay, and pasture. They are suited to most cultivated crops common to the county if good management practices are used, but they are poorly suited to corn. These soils are suited to grasses. Native grasses are mainly green needlegrass, western wheatgrass, and blue grama.

Representative profile of Moreau silty clay, nearly level, in a cultivated field, 380 feet south and 1,146 feet west of the northeast corner of sec. 24, T. 132 N., R. 99 W.:

Ap—0 to 5 inches, grayish-brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; moderate, medium, subangular blocky structure parting to moderate, medium, granular structure; hard dry, friable moist, sticky and plastic wet; slight effervescence; moderately alkaline; clear, smooth boundary.

B21—5 to 11 inches, light brownish-gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak, coarse and medium, prismatic structure parting to strong, medium and fine, angular blocky structure; extremely hard dry, firm moist, very sticky and very plastic wet; slight effervescence; moderately alkaline; gradual, wavy boundary.

B22—11 to 15 inches, light-gray to gray (2.5Y 6/1) silty clay, dark gray (2.5Y 4/1) moist; weak, coarse and medium, prismatic structure parting to moderate, medium and fine, angular blocky structure; extremely hard dry, firm moist, very sticky and very plastic wet; strong effervescence; moderately alkaline; gradual, wavy boundary.

B3ca—15 to 22 inches, light-gray to gray and olive-gray (2.5Y 6/1 and 5Y 5/2) silty clay, dark gray and olive gray (2.5Y 4/1 and 5Y 4/2) moist; concretions, 3 inches in diameter, of yellowish brown (10YR 5/6) moist; weak, coarse, angular blocky structure parting to moderate, medium and fine, angular blocky structure; extremely hard dry, firm moist, very sticky and very plastic wet; violent effervescence; few nodular segregations of carbonates; moderately alkaline; gradual, wavy boundary.

C1—22 to 35 inches, light olive-gray and pale-olive (5Y 6/2 and 6/3) platy shale, dark gray and olive (5Y 4/1 and 4/3) moist; extremely hard dry, very firm moist, very sticky and very plastic wet; strong effervescence; moderately alkaline; gradual, wavy boundary.

C2—35 to 55 inches, light olive-gray (5Y 6/2) platy shale, olive gray (5Y 4/2) moist; concretions, 7 to 10 inches in diameter, of dark yellowish brown and yellowish brown (10YR 4/4) and 5/6); extremely hard dry, very firm moist, very sticky and very plastic wet; strong effervescence; moderately alkaline; clear, wavy boundary.

IIC3—55 to 60 inches, light-gray (5Y 7/2) siltstone, olive gray (5Y 5/2) moist; extremely hard dry, very firm moist, sticky and plastic wet; strong effervescence; moderately alkaline.

The solum ranges from 15 to 25 inches in thickness. Depth to carbonates ranges from 0 to 14 inches. Depth to sedimentary beds is 20 to 30 inches in most places but ranges from 20 to 40 inches. A weak crust forms on the surface in places. The A horizon is grayish-brown or dark grayish-brown silty clay loam, silty clay, or clay. It ranges from neutral to moderately alkaline and is 4 to 8 inches thick. The B horizon is olive-gray, grayish-brown, or light brownish-gray silty clay or clay. It is mildly alkaline or moderately alkaline. The B horizon has weak or moderate structure. The sedimentary beds in the C horizon are soft shale.

Moreau soils are associated with Lawther, Regent, and Wayden soils. They have thinner A and B horizons than

Lawther and Regent soils. They have thicker A and B horizons than Wayden soils.

Moreau silty clay, nearly level (MrA).—This soil is on uplands. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Regent silty clay loam or silty clay, Lawther silty clay, and Rhoades silty clay loam.

Runoff is slow to medium, and the hazard of water erosion is slight. This soil is susceptible to soil blowing. Controlling soil blowing, conserving moisture, and maintaining organic-matter content and fertility are needs of management.

Most areas of this soil are cultivated. It is suited to most cultivated crops if good management practices are used. Capability unit IIIes; Clayey range site; windbreak suitability group 4.

Moreau silty clay, gently sloping (MrB).—This soil is on uplands. Slopes range from 3 to 6 percent. A few areas contain stones.

Included with this soil in mapping are small areas of Regent silty clay loam or silty clay, Lawther silty clay, and Rhoades silty clay loam. Also included are a few areas where the soils are moderately eroded and 501 acres of Regent silty clay, gently sloping.

Runoff is medium, and the hazard of water erosion is moderate. This soil is susceptible to soil blowing. Controlling soil blowing, conserving moisture, and maintaining organic-matter content and fertility are needs of management.

Most areas of this soil are cultivated. It is suited to cultivated crops if good management practices are used. Capability unit IIIes; Clayey range site; windbreak suitability group 4.

Moreau-Wayden silty clays, sloping (MwC).—The soils in this complex are on uplands. Slopes are 6 to 9 percent. The complex is 55 percent Moreau silty clay, 25 percent Wayden silty clay, and 20 percent other soils. Moreau soils are deeper than Wayden soils. They are in the middle and lower positions on the landscape, and Wayden soils are in the higher convex positions.

Moreau silty clay has a profile similar to that described as representative of the Moreau series, but it has a thinner surface layer and subsoil.

Wayden silty clay has a profile similar to that described as representative of the Wayden series.

Included with these soils in mapping are small areas of Regent silty clay, Lawther silty clay, and Rhoades silty clay loam.

Runoff is rapid on the soils in this unit. The hazards of water erosion and soil blowing are severe. Controlling water erosion and soil blowing, conserving moisture, and maintaining organic-matter content and fertility are needs of management.

Much of the acreage of these soils is cultivated. These soils are suited to cultivation if good management practices are used. Both soils in capability unit IVes–4; Moreau part in Clayey range site; windbreak suitability group 4. Wayden part in Shallow range site; windbreak suitability group 8.

Morton Series

This series consists of moderately deep, well-drained, nearly level to sloping soils on uplands. These soils formed in soft silty shale.

In a representative profile the surface layer is dark grayish-brown silty clay loam about 7 inches thick. The subsoil is friable, silty clay loam about 22 inches thick. The upper 18 inches is grayish brown, and the lower 4 inches is light brownish gray. The underlying material is gray silt loam about 6 inches thick over sedimentary beds of soft, silty shale.

Permeability and organic-matter content are moderate. Available water capacity is moderate to high. Fertility is high. Tilth is good.

Most areas of these soils are used for crops. Some areas are in native range, and green needlegrass, needle-and-thread, and blue grama are the main species. These soils are suited to cultivated crops, trees, and grasses commonly grown in the county.

Representative profile of a Morton silty clay loam in an area of Chama and Morton silty clay loams, gently sloping, in a cultivated field, 170 feet west and 0.2 mile north of the southeast corner of sec. 11, T. 131 N., R. 100 W.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse and medium, crumb structure; friable moist, sticky and slightly plastic wet; neutral; abrupt, smooth boundary.

B21t—7 to 17 inches, grayish-brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate, coarse and medium, prismatic structure parting to moderate, coarse and medium, angular blocky structure; continuous distinct clay films on faces of peds, very dark grayish brown (10YR 3/2) moist; friable moist, slightly sticky and slightly plastic wet; neutral; clear, smooth boundary.

B22t—17 to 25 inches, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, coarse and medium, prismatic structure parting to angular blocky structure; patches of clay films on faces of peds, very dark grayish brown (2.5Y 3/2) moist; friable moist, slightly sticky and slightly plastic wet; mildly alkaline; abrupt, smooth boundary.

B3ca—25 to 29 inches, light brownish-gray (2.5Y 6/3) silty clay loam, light olive brown (2.5Y 5/3) moist; weak, medium, prismatic structure parting to weak, medium and fine, subangular blocky structure; friable moist, slightly sticky and slightly plastic wet; violent effervescence; moderately alkaline; clear, smooth boundary.

C1—29 to 35 inches, gray (5Y 5/1), moist, silt loam, banded with yellowish brown (10YR 5/6) moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky structure; strong effervescence; moderately alkaline; clear, smooth boundary.

C2—35 to 60 inches, light olive-brown and pale-olive (2.5Y 5/4 and 5Y 6/3), moist, strata of soft sedimentary beds; weathered in upper part; moderately alkaline; strong effervescence.

The solum ranges from 17 to 34 inches in thickness. Depth to carbonates ranges from 10 to 30 inches. Depth to sedimentary beds is 30 to 40 inches in most places, but it ranges from 20 to 40 inches. The A horizon is dark grayish-brown, dark-brown, or grayish-brown loam, silt loam, clay loam, or silty clay loam. It is slightly acid or neutral and 4 to 9 inches thick. The B horizon is grayish-brown, brown, or

light grayish-brown silty clay loam or clay loam. It ranges from neutral to moderately alkaline. The B2t horizon has moderate or strong structure. Clay films are evident on the peds in the B2 horizon in most places. The sedimentary beds in the C horizon are soft shale and very fine-grained sandstone that have a crushed texture of loam, silt loam, or silty clay loam.

Morton soils are associated with Cabba, Chama, and Regent soils. They have thicker A and B horizons than Cabba soils. They have a more pronounced structure than Chama soils. They are coarser textured than Regent soils.

Oburn Series

This series consists of moderately deep, well-drained, nearly level soils on high terraces. These soils formed in alluvium. They are underlain by gravel.

In a representative profile the surface layer is brown silt loam about 3 inches thick. The subsurface layer is light brownish-gray silt loam about 4 inches thick. The subsoil is about 19 inches thick. The upper part is brown clay, the middle part is grayish-brown clay, and the lower part is grayish-brown clay loam. Segregations of carbonates are visible in the middle and lower parts of the subsoil. The underlying material is grayish-brown silty clay about 10 inches thick over gravel.

Permeability is slow. Organic-matter content is moderate. Available water capacity and fertility are low. The slowly permeable subsoil is penetrated by few plant roots. Most of the roots that do penetrate the columnar-structured subsoil are between the columns.

These soils are in native grasses. Native vegetation includes blue grama, pricklypear, and sagebrush. They are not suited to cultivated crops or trees.

Representative profile of an Oburn silt loam in an area of Oburn complex, in native grass, 627 feet east and 297 feet north of center of sec. 8, T. 130 N., R. 106 W.:

A1—0 to 3 inches, brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; soft dry, friable moist, slightly sticky and slightly plastic wet; slightly acid; abrupt, smooth boundary.

A2—3 to 7 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate, thin, platy structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; slightly acid; clear, smooth boundary.

B21t—7 to 10 inches, brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; peds coated with very dark grayish brown (10YR 3/2) moist; strong, medium, columnar structure; very hard dry, firm moist, very sticky and very plastic wet; neutral; clear, smooth boundary.

B22t—10 to 15 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; peds coated with very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure parting to strong, medium, angular blocky structure; extremely hard dry, very firm moist, very sticky and very plastic wet; moderately alkaline; gradual, wavy boundary.

B3ca—15 to 26 inches, grayish-brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, medium, prismatic structure parting to moderate, medium, angular blocky structure; extremely hard dry, extremely firm moist, very plastic and sticky wet; violent effervesence; many segregations of lime; moderately alkaline; gradual, wavy boundary.

Ccsca—26 to 36 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (10YR 4/2) moist; extremely hard dry, very firm moist, very sticky and very plastic wet; violent effervescence; many segregations of lime and salt crystals; moderately alkaline; clear, smooth boundary.

IIc—36 to 60 inches, gravel; strongly alkaline.

The solum ranges from 12 to 32 inches in thickness. Visible salts occur from 4 to 20 inches below the surface. Depth to gravel typically is 30 to 40 inches, but it ranges from 20 to 40 inches. The A horizon is grayish-brown or brown loam, silt loam, or clay loam. It ranges from slightly acid to mildly alkaline and is 2 to 5 inches thick. The A2 horizon ranges from a thin coating on the rounded tops of the columns to 7 inches in thickness. The B2t horizon is grayish-brown or brown silty clay or clay. It ranges from neutral to strongly alkaline. The horizon has moderate or strong structure. The C horizon is mottled in places.

Oburn soils are associated with Rhoades and Absher soils, but they differ from Rhoades and Absher soils in having gravel at a depth of 30 to 40 inches.

Oburn complex (Ob).—The nearly level soils in this complex are on old high terraces. The complex is about 45 percent Oburn silt loam, 30 percent Oburn loam, clay loam, or silty clay loam, and 25 percent slick spots. In areas in native grasses, the landscape has a pitted microrelief. The pitted areas are known locally as slick, scab, pan, or gumbo spots. These spots have little or no vegetation and absorb water slowly.

These soils have a profile similar to that described as representative of the Oburn series, but in places the surface layer is loam, clay loam, or silty clay loam.

Included with these soils in mapping are small areas of Wabek soils.

Runoff is slow on level areas and medium where slopes are 2 and 3 percent.

These soils are used for grazing. They are not suited to cultivation. Controlling grazing is a necessary part of good management. Capability unit VIs–TC; Thin Claypan range site; windbreak suitability group 9.

Parshall Series

This series consists of deep, well-drained, nearly level soils in swales, shallow depressions, and intermittent drainageways. These soils formed in fine sandy loam and loamy fine sand alluvium.

In a representative profile the surface layer is dark-gray fine sandy loam about 14 inches thick. The subsoil is very friable fine sandy loam about 16 inches thick. The upper part is dark grayish brown, and the lower part is grayish brown. The loamy fine sand underlying material is light brownish gray to a depth of about 42 inches and light gray and pale yellow below this depth.

Permeability is moderately rapid. Available water capacity is moderate. Organic-matter content and fertility are high. Tilth is good. Some of these soils have potential for irrigation. These soils are highly susceptible to soil blowing.

Nearly all areas of these soils are cultivated. A few areas are in native grasses, and prairie sandreed, western wheatgrass, needle-and-thread, and blue grama are the principal species. These soils are suited to cultivated crops, trees, and grasses.

Representative profile of Parshall fine sandy loam, nearly level, in a cultivated field, 1,020 feet east and 195 feet north of southwest corner of SE¼ sec. 13, T. 131 N., R. 101 W.:

Ap—0 to 7 inches, dark-gray (10YR 4/1) fine sandy loam, very dark brown (10YR 2/2) moist; weak, coarse, subangular blocky structure parting to weak, medium and fine, crumb structure; slightly hard dry, very friable moist, nonplastic and slightly sticky wet; neutral; abrupt, smooth boundary.

A1—7 to 14 inches, dark-gray (10YR 4/1) fine sandy loam, very dark brown (10YR 2/2) moist; weak, coarse, prismatic structure parting to moderate, coarse and medium, subangular blocky, and weak, fine, subangular blocky structure; slightly hard dry, very friable moist, slightly sticky and nonplastic wet; neutral; clear, wavy boundary.

B2—14 to 24 inches, dark grayish-brown (2.5Y 4/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; weak, coarse, prismatic structure parting to moderate, coarse and medium, subangular blocky and weak, fine, subangular blocky structure; slightly hard dry, very friable moist, slightly sticky and nonplastic wet; neutral; clear, wavy boundary.

B3—24 to 30 inches, grayish-brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure parting to moderate, medium and fine, subangular blocky structure; soft dry, very friable moist, nonsticky and nonplastic wet; neutral; clear, wavy boundary.

C1—30 to 42 inches, light brownish-gray (2.5Y 6/2) loamy fine sand, olive brown (2.5Y 4/4) moist; soft dry, very friable moist, nonsticky and nonplastic wet; strong effervescence; mildly alkaline; clear, wavy boundary.

C2—42 to 60 inches, light-gray (2.5Y 7/2) and pale-yellow (5Y 7/3) loamy fine sand, light brownish gray (2.5Y 6/2) and pale olive (5Y 6/3) moist; loose dry, nonsticky and nonplastic wet; slight effervescence; moderately alkaline.

The solum ranges from 24 to 46 inches in thickness. Depth to carbonates ranges from 24 to 56 inches. The A horizon is dark grayish-brown, dark-gray, or very dark grayish-brown fine sandy loam or sandy loam. It is slightly acid or neutral and 10 to 20 inches thick. The B horizon is grayish-brown, dark-gray, or dark grayish-brown fine sandy loam or sandy loam. It ranges from neutral to moderately alkaline. The B horizon has weak or moderate structure. The C horizon is loamy fine sand, fine sandy loam, or sandy loam.

Parshall soils are associated with Arnegard and Tally soils. They are finer textured than Arnegard soils. They are darker colored to a greater depth than Tally soils.

Parshall fine sandy loam, nearly level (PaA).—This soil is in drainageways, depressions, and swales. Most areas are long and narrow.

Included with this soil in mapping are small areas of Tally fine sandy loam, Arnegard loam, and Grail soils, saline.

Runoff is slow to medium. This soil receives runoff from adjacent areas. It is highly susceptible to soil blowing. Controlling soil blowing is a necessary part of good management.

Most areas of this soil are cultivated. Only a few scattered areas remain in grasses. This soil is well suited to cultivated crops if good management practices are used. It is well suited to trees. Capability unit IIIe–3; Sandy range site; windbreak suitability group 1.

Patent Series

This series consists of deep, well-drained, gently sloping to sloping soils on fans and slopes below steep and hilly land. These soils formed in loamy alluvium.

In a representative profile the surface layer is light brownish-gray loam about 6 inches thick. Below is friable, light brownish-gray silt loam about 6 inches thick over layers of friable, pale-olive, light brownish-gray, and light olive-gray loam and silt loam.

Permeability and available water capacity are moderate. Organic-matter content is moderately low. Fertility is medium. These soils are susceptible to soil blowing. Water erosion is a hazard where slopes are more than 3 percent.

These soils are used mainly for grazing, but some areas are used for hay and other areas are cultivated. Native grasses include green needlegrass, western wheatgrass, and blue grama. Where slopes are as much as 6 percent, these soils are suited to cultivation if good management practices are used.

Representative profile of Patent loam, gently sloping, in a cultivated field, 903 feet east and 730 feet north of southwest corner of sec. 22, T. 132 N., R. 104 W.:

Ap—0 to 6 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, subangular blocky structure parting to weak, medium, crumb structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; slight effervescence; mildly alkaline; abrupt, smooth boundary.

C1—6 to 12 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak, medium and coarse, prismatic structure parting to moderate, fine and medium, platy structure; slightly hard dry, friable moist; strong effervescence; moderately alkaline; gradual, wavy boundary.

C2—12 to 20 inches, pale-olive (5Y 6/3) silt loam, olive (5Y 5/3) moist; moderate, thin and medium, platy structure; hard dry, friable moist, slightly sticky and slightly plastic wet; violent effervescence; lime concentrated on the horizontal surfaces of plates; moderately alkaline; gradual, wavy boundary.

IIC3—20 to 36 inches, light olive-gray (5Y 6/2) loam, olive gray (5Y 5/2) moist; moderate, medium and thin, platy structure; hard dry, friable moist, slightly sticky and slightly plastic wet; strong effervescence; lime concentrated on the horizontal faces of the plates; moderately alkaline; gradual, wavy boundary.

IIC4—36 to 45 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; coarse, weak, platy structure; hard dry, friable moist, slightly sticky and slightly plastic wet; strong effervescence; lime concentrated on horizontal surfaces; moderately alkaline.

Texture is mainly loam or silt loam but in places is silty clay loam. Stratification is evident in most places. A buried A horizon, gravel lenses, and small pieces of lignite or porcellanite are in some places. The A horizon is light brownish-gray, light olive-gray, or grayish-brown loam and silt loam. It is mildly alkaline or moderately alkaline and 3 to 8 inches thick. A very weak B horizon is in places.

Patent soils are associated with Cherry and Sham soils. They differ from Cherry soils in lacking a B2 horizon. They have less sand and are less alkaline than Sham soils.

Patent loam, gently sloping (PeB).—This soil is on fans on uplands. Slopes are mainly 3 to 6 percent but range from 0 to 6 percent. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Cherry, Sham, and Absher loams.

Runoff is medium, but small gullies have formed in some areas where runoff has concentrated. This soil is

highly susceptible to soil blowing. If it is used for row crops, water erosion is a hazard where slopes are more than 3 percent. Controlling water erosion and soil blowing, controlling grazing, conserving moisture; and maintaining organic-matter content are needs of management. Tilth is fair to poor.

Many areas of this soil are in range. Other areas are cultivated. This soil is suited to cultivated crops if good management practices are used. Capability unit IIIe–4L; Silty range site; windbreak suitability group 3.

Patent loam, sloping (PeC).—This soil is on fans on uplands. Slopes are mainly 6 to 9 percent but range from 6 to 12 percent.

Included with this soil in mapping are small areas of Cherry, Sham, and Absher loams.

Runoff is medium to rapid. Runoff from adjacent steep areas has caused rills and small gullies across fields in some places. This soil is highly susceptible to soil blowing. Water erosion is a severe hazard if this soil is overgrazed or tilled. The needs of management are controlling water erosion and grazing and maintaining organic-matter content and fertility.

This soil is mainly used for grazing. Some areas are used for hay. This soil is generally not suited to crops, but a few sloping areas are used for small grain. Capability unit VIe–Si; Silty range site; windbreak suitability group 3.

Reeder Series

This series consists of moderately deep, well-drained, nearly level to sloping soils on uplands. These soils formed in soft, loamy shale and fine-grained sandstone.

In a representative profile the surface layer is dark grayish-brown loam about 8 inches thick. The friable subsoil is about 24 inches thick. The friable subsoil is about 24 inches thick. The upper and middle parts are brown clay loam. The lower part is light brownish-gray loam. The underlying material is light yellowish-brown loam, about 4 inches thick, over soft, loamy sedimentary beds.

Permeability is moderate. Available water capacity is moderate to high. Organic-matter content is moderate. Fertility is high. Tilth is good.

Most areas of these soils are used for crops, but some areas are in native range, and green needlegrass, needle-and-thread, and blue grama are the principal species. These soils are suited to cultivated crops, trees, and grasses.

Representative profile of a Reeder loam in an area of Reeder-Shambo loams, gently sloping, in a cultivated field, 1,066 feet north and 475 feet west of southeast corner of NE¼ sec. 14, T. 129 N., R. 100 W.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak, coarse and fine, subangular blocky structure parting to weak, fine, crumb structure; friable moist; many roots; many fine pores; neutral; abrupt, smooth boundary.

B21t—8 to 12 inches, brown (10YR 5/3) light clay loam, dark brown (10YR 3/3) moist; moderate, coarse and medium, prismatic structure parting to moderate, medium, angular blocky structure; friable moist; common roots; many fine pores; thin continuous clay films on vertical faces and patches on horizontal faces of peds; neutral; clear, smooth boundary.

B22t—12 to 17 inches, brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, prismatic structure parting to moderate, medium, angular blocky structure; friable moist; patches of clay films on faces of peds; neutral; gradual, wavy boundary.

B3ca—17 to 32 inches, light brownish-gray (2.5Y 6/3) loam; dark grayish brown (2.5Y 4/3) moist; weak, coarse and medium, prismatic structure parting to moderate, medium, subangular blocky structure; friable moist; few roots; many fine pores; common lime nodules; strong effervescence; moderately alkaline; gradual, wavy boundary.

C1ca—32 to 36 inches, light yellowish-brown (2.5Y 6/4) loam, light olive brown (2.5Y 5/4) moist; weak, medium, subangular blocky structure; friable moist; few fine roots; many fine threads and masses of lime; violent effervescence; moderately alkaline; gradual, wavy boundary.

C2—36 to 60 inches, pale-yellow (5Y 7/3) stratified beds of fine-grained sandstone, siltstone, and loamy shale, olive (5Y 5/3) moist; few lime segregations; slight effervescence; strongly calcareous, moderately alkaline.

The solum ranges from 15 to 34 inches in thickness. Depth to carbonates ranges from 12 to 24 inches. Depth to sedimentary beds in most places is 30 to 40 inches, but it ranges from 20 to 40 inches. The A horizon is dark grayish-brown, grayish-brown, or dark-brown, silt loam, or clay loam. It is slightly acid or neutral and is 4 to 9 inches thick. The B2t horizon is brown, dark-brown, or grayish-brown clay loam or loam. It ranges from neutral to moderately alkaline. The structure of the B2t horizon is moderate or strong. Clay films are evident in most places on the faces of peds in the B2t horizon. The sedimentary beds in the C horizon are soft shale and very fine grained sandstone.

Reeder soils are associated with Amor, Cabba, Grail, and Shambo soils. They have a finer textured B2t horizon than Amor soils. They have thicker A and B horizons than Cabba soils. They contain less clay than Grail soils. They differ from Shambo soils in having bedrock within a depth of 40 inches.

Reeder-Cabba loams, sloping (RcC).—The soils in this complex are on uplands. Slopes are 6 to 9 percent. The complex is about 60 percent Reeder loam, 15 percent Cabba loam, and 25 percent included soils. Reeder soils are deeper than Cabba soils. Reeder soils are in the middle and lower positions on the landscape, and Cabba soils are on convex higher parts.

The Reeder loam has a profile similar to that described as representative of the Reeder series, but the surface layer and subsoil are thinner.

The Cabba loam has a profile similar to that described as representative of the Cabba series, but the surface layer and subsoil are thicker, and the surface layer is loam instead of silt loam.

Included with these soils in mapping are small areas of Amor, Arnegrad, and Shambo loams and Morton silt loam. Also included are about 434 acres of soils that are moderately eroded. About 35 percent of the eroded soils appear as light colored areas in cultivated fields. Most of the erosion has been caused by runoff during intense rainstorms when the soil was in summer fallow.

Runoff is medium to rapid. The hazard of erosion is moderate. Controlling water erosion, conserving moisture, and maintaining organic-matter content and fertility are the main needs of management.

Most areas of these soils are cultivated, but some areas remain in grasses. This soil is suited to cultivated crops if good management practices are used. Both soils in capability unit IIIe–6; Reeder part in Silty range site; windbreak suitability group 3; Cabba part in Shallow range site; windbreak suitability group 8.

Reeder-Rhoades complex, nearly level (RdA).—The soils in this complex are on uplands. The complex is 60 to 85 percent Reeder and Amor loams and silt loams, 5 to 35 percent Rhoades silt loam or loam, 15 to 25 percent Daglum and Belfield silt loams, and 5 to 15 percent included soils. In areas in native grasses, the microrelief is pitted. The pitted areas are locally known as slick, scab, pan, or gumbo spots. These spots have little or no vegetation and absorb water slowly. In cultivated areas they are dispersed and puddled. In most places the spots are Rhoades soils that have lost the material in the surface layer through erosion.

The profile of Reeder soils is similar to that described as representative of the Reeder series, but the salt content in the lower part of the subsoil is higher and in places the surface layer is silt loam.

The profile of the Rhoades soils is similar to that described as representative of the Rhoades series, but in places the surface layer is silt loam.

Included with these soils in mapping are small areas of Regent silty clay loam, Shambo loam, and Moreau silty clay loam.

Runoff is slow to medium. Available water capacity is moderate to low where the Rhoades soils occur near Daglum soils. Crops are thus adversely affected during years of below-normal rainfall. Some soils in this complex have poor tilth. The main concerns of management are improving tilth, conserving moisture, and maintaining organic-matter content and fertility.

Most areas of these soils are cultivated, but some areas remain in grasses. The soils in this complex are suited to most crops commonly grown in the county. The soils are poorly suited to corn. Crops emerge and develop slowly in the dispersed areas. Both soils in capability unit IIIs–P; Reeder part in Silty range site; windbreak suitability group 3; Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Reeder-Rhoades complex, gently sloping (RdB).—The soils in this complex are on uplands. Slopes are 3 to 6 percent. The complex is 60 to 80 percent Reeder and Amor loams and silt loams, 5 to 35 percent Rhoades silt loam or loam, 15 to 30 percent Daglum and Belfield silt loams, and 5 to 15 percent included soils. In areas in native grasses, the microrelief is pitted. The pitted areas are locally known as slick, scab, pan, or gumbo spots. These spots have little or no vegetation and absorb water slowly. In cultivated areas they are dispersed and puddled. In most places the spots are Rhoades soils that have lost the surface layer through erosion.

The profile of the Reeder soils is similar to that described as representative of the Reeder series, but the salt content in the lower part of the subsoil is higher, and in places the surface layer is silt loam.

The profile of the Rhoades soils is similar to that described as representative of the Rhoades series, but in places the surface layer is silt loam.

Included with these soils in mapping are small areas of Regent silt clay loam, Morton silt loam, and Moreau silty clay loam. Also included are a few acres where the soil is moderately eroded.

Runoff is medium. Water erosion is a hazard. Available water capacity is moderate to low where Rhoades soils occur near Daglum soils. This affects crops during years of below-normal rainfall. Controlling water erosion, improving tilth, conserving moisture, and maintaining organic-matter content and fertility are the main needs of management.

Most areas of these soils are cultivated, but some areas remain in grasses. The soils are suited to most crops commonly grown in the county if good management practices are used. They are poorly suited to corn. Crops emerge and develop slowly in the dispersed areas. Both soils in capability unit IIIe–P; Reeder part in Silty range site; windbreak suitability group 3. Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Reeder-Rhoades complex, sloping (RdC).—The soils in this complex are on uplands. Slopes are 6 to 9 percent. The complex is 50 to 80 percent Reeder and Amor loams and silt loams, 5 to 20 percent Chama silt loam, 5 to 35 percent Rhoades silt loam or loam, 15 to 30 percent Daglum and Belfield silt loams, and 5 to 15 percent included soils. In areas in native grasses, the microrelief is pitted. The pitted areas are locally known as slick, scab, pan, or gumbo spots. These spots have little or no vegetation and absorb water slowly. In cultivated areas these spots are dispersed and puddled. In most places the spots are Rhoades soils that have lost the material in the surface layer through erosion.

The profile of the Reeder soils is similar to that described as representative of the Reeder series, but the salt content in the lower part of the subsoil is higher, and in places the surface layer is silt loam.

The profile of the Rhoades soils is similar to that described as representative of the Rhoades series, but in places the surface layer is silt loam.

Included with these soils in mapping are small areas of Cabba and Morton silt loams and a small acreage of Reeder-Rhoades complex, strongly sloping.

Runoff is rapid to medium. The hazard of water erosion is severe. Controlling water erosion, improving tilth, conserving moisture, and maintaining organic-matter content and fertility are the main needs of management.

Much of the acreage of these soils is cultivated. The soils are suited to most crops commonly grown in the county if good management practices are used. The soils are poorly suited to corn. Crops emerge and develop slowly in the dispersed areas. Both soils in capability unit IVe–P; Reeder part in Silty range site; windbreak suitability group 3; Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Reeder-Shambo loams, nearly level (ReA).—The soils in this complex are on uplands. The complex is about 55 percent Reeder loam, 30 percent Shambo loam, and 15 percent included soils. Reeder soils are not so deep as Shambo soils and are in higher positions on the landscape.

The profile of the Reeder loam is similar to that described as representative of the Reeder series, but the surface layer and subsoil are thicker.

The profile of the Shambo loam is similar to that described as representative of the Shambo series.

Included with these soils in mapping are small areas of Arnegard loam, Grail silt loam, and Amor loam and areas of Morton silt loam.

Runoff is slow to medium. The hazard of erosion is slight. Conserving moisture and fertility are concerns of management.

Most areas of these soils are cultivated. Only a few scattered areas remain in native grasses. The soils are well suited to cultivated crops. Both soils in capability unit IIc–6; Silty range site; windbreak suitability group 3.

Reeder-Shambo loams, gently sloping (ReB).—The soils in this complex are on uplands. Slopes are 3 to 6 percent. The complex is about 60 percent Reeder loam, 25 percent Shambo loam, and 15 percent included soils. Reeder soils are not so deep as Shambo soils and are on the higher parts of the landscape.

The profile of Reeder loam is the one described as representative of the Reeder series.

The profile of Shambo loam is similar to that described as representative of the Shambo series.

Included with these soils in mapping are small areas of Arnegard loam, Grail silt loam, and Amor and Cabba loams. Also included were areas of Morton silt loam and 553 acres of soils that are moderately eroded. About 35 percent of the eroded soils appear as light-colored areas in cultivated fields. In places the eroded soils have a plow layer consisting of material in the surface layer mixed with that in the subsoil. Most of the erosion has been caused by runoff during intense rainstorms in areas in summer fallow. Soil blowing occurs in spring before vegetation is established.

Runoff is medium. The hazard of water erosion is slight to moderate. Control of water erosion is a part of good management. Other concerns of management are conserving moisture and maintaining fertility.

Most areas of these soils are cultivated. The soils are well suited to cultivated crops if good management practices are used. Both soils in capability unit IIe–6; Silty range site; windbreak suitability group 3.

Reeder and Amor very stony loams (Rf).—In this mapping unit are soils on uplands. Slopes are 0 to 9 percent. The soils contain numerous stones 5 to 48 inches in length. Some areas of this unit are part Reeder loam and silt loam and part Amor loam and silt loam. Other areas are all Reeder soils or all Amor soils.

Reeder and Amor soils have profiles similar to those described as representative of their respective series, but they contain stones and the surface layer is silt loam in places.

Included with these soils in mapping were small areas of Morton silt loam.

Runoff is medium on the soils in this unit. The hazard of erosion is slight. Tillage is impractical because of the numerous stones on the surface and within the surface layer. Needs of management are controlling grazing and maintaining fertility and organic-matter content.

All areas of these soils are in native grasses and are used for grazing. Some areas have potential for use as wildlife habitat. The stones are accessible in most places and are used as construction material for dams and roads. Management practices that maintain fertility and organic-matter content are needed. Capability unit VIIs–Si; Silty range site; windbreak suitability group 10.

Regan Series

This series consists of deep, poorly drained, nearly level soils on fans, in swales, and on concave slopes. These soils formed in alluvium.

In a representative profile the surface layer is gray silt loam about 9 inches thick. Below this layer is 18 inches of very friable and friable silt loam that is light gray in the upper part, grayish brown in the middle part, and light brownish gray in the lower part. This is underlain by pale-yellow silty clay loam, light yellowish-brown clay loam, and light yellowish-brown silty clay that extend to a depth of 60 inches. The content of lime is high throughout most of the profile, except for the upper 2 inches of the surface layer.

Permeability and available water capacity are moderate. About one-half of the time a water table is below a depth of 36 inches. Organic-matter content is high, and fertility is medium. Tilth is poor to fair.

Most areas of these soils are used for pasture or hay. Some of the better drained areas are used for alfalfa and small grain.

Representative profile of Regan silt loam in native grass, 1,209 feet west and 1,089 feet south of the northeast corner of sec. 34, T. 132 N., R. 103 W.:

A11—0 to 2 inches, gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; strong, fine, granular structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; slight effervescence; moderately alkaline; smooth, abrupt boundary.

A12—2 to 6 inches, gray (2.5Y 5/1) silt loam, very dark grayish brown (2.5Y 3/2) moist; weak, medium and fine, subangular blocky structure parting to moderate, medium and fine, granular structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; violent effervescence; many segregations of lime; moderately alkaline; clear, smooth boundary.

A13—6 to 9 inches, gray (10YR 5/1) silt loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure parting to moderate, medium and fine, granular structure; slightly hard dry, very friable moist, slightly sticky and slightly plastic wet; violent effervescence; many soft masses of segregated lime; moderately alkaline; abrupt, smooth boundary.

C1ca—9 to 13 inches, light-gray to gray (5Y 6/1) silt loam, olive gray (5Y 4/2) moist; weak, coarse, subangular blocky structure parting to moderate, medium and fine, granular structure; slightly hard dry, very friable moist, slightly sticky and slightly plastic wet; violent effervescence; many segregations of lime; moderately alkaline; gradual boundary.

C2ca—13 to 19 inches, grayish-brown (2.5Y 5/2) silt loam, very dark grayish brown (2.5Y 3/2) moist; weak, coarse and medium, subangular blocky structure and moderate, medium and fine, granular structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; violent effervescence; many segregations of lime; moderately alkaline; gradual boundary.

C3ca—19 to 27 inches, light brownish-gray (2.5Y 6/2) silt loam, olive brown (2.5Y 4/3) moist; weak, fine, angular blocky structure and moderate, fine, granular structure; slightly hard dry, friable moist, sticky and plastic wet; violent effervescence; common segregations of lime; moderately alkaline; gradual boundary.

IIC4ca—27 to 35 inches, pale-yellow (2.5Y 7/4) silty clay loam, light olive brown (2.5Y 5/6) moist; moderate, fine and very fine, angular blocky structure; hard dry, friable moist, sticky and plastic wet; violent effervescence; many segregations of lime; moderately alkaline; gradual boundary.

IIC5ca—35 to 45 inches, light yellowish-brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/6) moist; massive; sticky and plastic wet; 20 percent scoria and gravel fragments; violent effervescence; few segregations of lime; moderately alkaline; gradual boundary.

IIIC6ca—45 to 60 inches, light yellowish-brown (2.5Y 6/4) silty clay, light olive brown (2.5Y 5/6) and dark gray (5Y 4/1) moist; massive; very sticky and very plastic wet; 10 percent scoria and gravel fragments; violent effervescence; moderately alkaline.

Texture is silt loam or silty clay loam. Gravel lenses or a buried A horizon is in some places, and gleyed colors and mottles are in some places. The A horizon is dark-gray, gray, dark-brown, or dark grayish-brown loam, silt loam, or silty clay loam and ranges from 4 to 10 inches in thickness. The boundary between the A horizon and the Cca horizon ranges from smooth to irregular. The C horizon is stratified in some places.

Regan soils are associated with Arnegard and Grail soils. They have a higher content of lime and poorer drainage than Arnegard soils. They lack the B horizon of Grail soils.

Regan silt loam (Rg).—This soil is on fans and concave slopes and in swales. Slopes are 0 to 3 percent. Areas are flat or slightly concave. This soil is saline and high in lime content because of poor drainage and a seasonal water table.

Included with this soil in mapping are small areas of Arnegard, Daglum, and Grail silt loams and Grail soils, saline.

Runoff is slow to medium, and the hazard of erosion is slight.

Much of this soil is used for pasture and hay. Only limited cropping is feasible. This soil is better suited to alfalfa and to salt-tolerant grasses than to most other plants. Where this soil is cultivated, germination and emergence of seedlings is poor because of the saline condition. In the wetter areas artificial drainage is needed if crops are grown. Capability unit IIIws–4; Wet Meadow range site; windbreak suitability group 10.

Regent Series

This series consists of moderately deep, well-drained, nearly level to sloping soils on uplands. These soils formed in soft shale.

In a representative profile the surface layer is dark grayish-brown silty clay loam about 7 inches thick. The subsoil is firm silty clay about 30 inches thick. The upper part is grayish brown, the middle part is olive, and the lower part is pale olive and contains segregated carbonates. The underlying material is pale-olive and grayish-brown soft shale sedimentary beds with a crushed texture of silty clay loam and silty clay.

Permeability is slow. Available water capacity is moderate to high. Organic-matter content is moderate. Fertility is high. The soils shrink and crack when dry.

Nearly all areas of these soils are used for crops, but some areas remain in native range, and green needlegrass, western wheatgrass, and blue grama are the principal species. These soils are suited to cultivated crops, trees, and grasses commonly grown in the county.

Representative profile of Regent silty clay loam, gently sloping, in a cultivated field, 155 feet east and 350 feet north of southwest corner of NW¼ sec. 13, T. 131 N., R. 99 W.:

Ap—0 to 7 inches, dark grayish-brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate, medium and fine, granular structure; hard dry, friable moist, sticky and plastic wet; neutral; abrupt, smooth boundary.

B21t—7 to 18 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; peds coated with very dark grayish brown (2.5Y 3/2) moist; moderate, coarse and medium, prismatic structure parting to moderate, medium and fine, angular blocky structure; very hard dry, firm moist, sticky and very plastic wet; mildly alkaline; clear, wavy boundary.

B22t—18 to 26 inches, olive (5Y 5/3) silty clay, olive (5Y 4/3) moist; moderate, coarse and medium, prismatic structure parting to strong, coarse and medium, angular blocky structure; hard dry, firm moist, sticky and very plastic wet; strong effervescence; few lime masses, light brownish gray (2.5Y 6/2) moist; moderately alkaline; clear, wavy boundary.

B3ca—26 to 37 inches, pale-olive (5Y 6/3) silty clay, olive (5Y 5/4) moist; weak, coarse and medium, prismatic structure parting to strong, coarse and medium, angular blocky structure; very hard dry, firm moist, sticky and very plastic wet; violent effervescence; common segregations of carbonates; moderately alkaline; clear, wavy boundary.

C1—37 to 60 inches, pale-olive (5Y 6/3) stratified soft silty clay loam and silty clay sedimentary beds, weathered in upper part, olive (5Y 5/3) moist; violent effervescence to strong effervescence with depth; common segregations of carbonates; moderately alkaline.

The A and B horizons range from 20 to 40 inches in thickness. Depth to carbonates ranges from 10 to 20 inches. Depth to bedrock in most places is 34 to 40 inches but ranges from 20 to 40 inches. The A horizon is grayish-brown, or olive-gray silty clay loam, clay loam, or silty clay. It is neutral or mildly alkaline and is 4 to 9 inches thick. The B horizon is grayish-brown, olive, and light brownish-gray silty clay or clay. The blocky structure of the B horizon is moderate or strong. Coats on faces of peds are thin films of darker colored clay and organic matter, but they are lacking in some places. The sedimentary beds in the C horizon are soft shale.

Regent soils are associated with the Grail, Lawther, Moreau, and Morton soils. They are darker to a shallower depth than Grail soils. They have less clay in the A and B horizons than Lawther soils. They have thicker A and B horizons than Moreau soils.

Regent silty clay loam, nearly level (RhA).—This soil is on uplands. It has a profile similar to that described as representative of the series, but it has a thicker solum.

Included with this soil in mapping are small areas of Morton and Savage silty clay loams.

Runoff is slow to medium, and the hazard of erosion is slight. The main concerns of management are conserving moisture and maintaining organic-matter content and fertility.

Most areas of this soil are used for cultivated crops, but some areas remain in grasses. This soil is well suited to cultivated crops. Capability unit IIc–7; Clayey range site; windbreak suitability group 3.

Regent silty clay loam, gently sloping (RhB).—This soil is on uplands. Slopes are 3 to 6 percent. It has the profile described as representative of the series.

Included in mapping are small areas of Moreau, Morton, Savage, and Grail silty clay loams. Also included are a few areas that contain some stones. These areas are indicated on the soil map by the symbol for stone spot.

Runoff is medium. Erosion has been slight in most places. Runoff from higher areas has caused rill erosion in a few places. Controlling water erosion, conserving moisture, and maintaining fertility are the main concerns of management.

Most areas of this soil are used for cultivated crops, but some areas remain in grasses. This soil is well suited to cultivated crops if good management practices are used. Capability unit IIe–7; Clayey range site; windbreak suitability group 3.

Regent-Moreau silty clay loams, sloping (RkC).—The soils in this complex are on uplands. Slopes are 6 to 9 percent. The complex is about 60 percent Regent silty clay loam, 20 percent Moreau silty clay loam, and 20 percent included soils. Regent soils are deeper than Moreau soils.

Included with this unit in mapping are 202 acres of Regent silty clay, sloping. Also included are small areas of Cabba, Morton, and Wayden silty clay loams and a few scattered areas that have stones on the surface and in the surface layer. These areas are indicated on the soil map by the symbol for stone spot.

The Regent soils have a profile similar to the one described as representative for the Regent series, but the surface layer and subsoil are thinner.

The Moreau soils have a profile similar to the one described as representative for the Moreau series, but the surface layer is silty clay loam.

Runoff is medium to rapid. The hazard of water erosion is moderate to severe. Erosion has been slight in most places. Runoff from higher areas has caused rill erosion in a few places. Controlling water erosion, conserving moisture, and maintaining organic-matter content and fertility are the main concerns of management.

Most areas of these soils are used for cultivated crops, but some areas remain in grasses. The soils are suited to cultivation if good management practices are used. Both soils in capability unit IIIe–7; Clayey range site; Regent part in windbreak suitability group 3. Moreau part in windbreak suitability group 4.

Regent-Moreau-Rhoades complex, gently sloping (R1B).—The soils in this complex are on uplands. Slopes are mainly 3 to 6 percent but range from 3 to 9 percent. The complex is 50 to 60 percent Regent silty clay loam and silty clay, 25 to 35 percent Moreau silty clay loam and silty clay, 5 to 35 percent Rhoades loam and clay loam, 5 to 15 percent Daglum and Belfield silty clay loams, and 5 to 15 percent other included soils. In areas in native grasses, the microrelief is pitted. The pitted areas are known as slick, scab, pan, or gumbo spots. These spots have little or no vegetation and absorb water slowly. In cultivated areas these spots are dispersed and puddled. In most places the spots are Rhoades soils that have lost the material in the surface layer through erosion.

The profile of the Regent soils is similar to that described as representative of the Regent series, but the salt content in the lower part of the subsoil is higher, and in places the surface layer is silty clay.

The profile of the Moreau soils is similar to that described as representative of the Moreau series, but the surface layer is more crusted and the salt content in the lower part of the subsoil is higher. Also, in places the surface layer is silty clay loam.

The profile of the Rhoades soils is similar to that described as representative of the Rhoades series, but in places the surface layer is clay loam.

Included with these soils in mapping are small areas of Wayden and Morton silty clay loams and Grail soils, saline.

Runoff is medium where slopes are less than 6 percent and rapid where slopes are greater than 6 percent. The hazard of water erosion is moderate to severe. Controlling water erosion, conserving moisture, improving tilth, and maintaining organic-matter content and fertility are the main needs of management. Available water capacity is moderate to low where Rhoades soils occur near Daglum soils. Crops are thus adversely affected during years of below-normal rainfall.

Many areas of these soils are cultivated. Other areas remain in grasses. The soils are suited to most crops commonly grown in the county if good management practices are used. The soils are poorly suited to corn. Crops emerge and develop slowly in dispersed areas. All soils in capability unit IIIe–P; Regent part in Clayey range site; windbreak suitability group 3. Moreau part in Clayey range site; windbreak suitability group 4. Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Regent-Rhoades complex, nearly level (RmA).—The soils in this complex are on uplands. The complex is 60 to 80 percent Regent silty clay loam and silty clay, 10 to 15 percent Moreau silty clay loam and silty clay, 5 to 35 percent Rhoades loam and silty clay, 10 to 20 percent Daglum and Belfield silty clay loams, and 5 to 15 percent other included soils. In areas in native grass, the microrelief is pitted. The pitted areas are known as slick, scab, pan, or gumbo spots. These spots have little or no vegetation and absorb water slowly. In cultivated areas these spots are dispersed and puddled. In most places the spots are Rhoades soils that have lost the material in the surface layer through erosion.

The profile of Regent soils is similar to that described as representative of the Regent series, but the content of salt in the lower part of the subsoil is higher and in places the surface layer is silty clay.

The profile of Rhoades soils is similar to that described as representative of the Rhoades series, but in places the surface layer is silty clay.

Included with these soils in mapping are small areas of Grail and Morton silty clay loams.

Runoff is slow to medium. Available water capacity is moderate to low where Rhoades soils occur near Daglum soils. Crops thus are adversely affected during years of below-normal rainfall. Needs of management are conserving moisture, improving tilth, and maintaining organic-matter content and fertility.

Much of the acreage of these soils is cultivated. The soils are suited to most crops commonly grown in the county if good management practices are used. They are poorly suited to corn. Crops emerge and develop slowly in the dispersed areas. Both soils in capability unit IIIs–P; Regent part in Clayey range site; windbreak suitability group 3. Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Rhame Series

This series consists of moderately deep, well-drained, gently sloping to hilly soils on uplands. These soils formed in soft sandstone.

In a representative profile the surface layer is grayish-brown fine sandy loam about 8 inches thick. The very friable fine sandy loam subsoil is about 18 inches thick. The upper part is brown, and the lower part is light yellowish brown. The underlying material is pale-yellow fine sandy loam, about 8 inches thick, over soft sandstone sedimentary beds.

Permeability is moderately rapid. Available water capacity is low to moderate. Fertility is medium. Organic-matter content is moderate. These soils are highly susceptible to soil blowing.

These soils are used for crops, hay, and range. Areas in native grases have needle-and-thread, prairie sandreed, and threadleaf sedge as the principal species. These soils are suited to cultivated crops, trees, and grasses common to the county.

Representative profile of Rhame fine sandy loam, gently sloping, in native grass, 260 feet east and 610 feet south of northwest corner of SW¼ sec. 16, T. 131 N., R. 106 W.:

A11—0 to 3 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; soft dry, very friable moist; many very fine roots, almost matted; neutral; clear, wavy boundary.

A12—3 to 8 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium and fine, subangular blocky structure; slightly hard dry, very friable moist; many very fine roots; neutral; gradual, wavy boundary.

B2—8 to 19 inches, brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to weak, coarse and medium, subangular blocky structure; slightly hard dry, very friable moist; many fine roots; neutral; gradual, wavy boundary.

B3—19 to 26 inches, light yellowish-brown (2.5Y 6/3) fine sandy loam, olive brown (2.5Y 4/3) moist; weak, coarse, prismatic structure parting to weak, coarse and medium, subangular blocky structure; slightly hard dry, very friable moist; common very fine roots; neutral; clear, wavy boundary.

C1—26 to 34 inches, pale-yellow (2.5Y 7/3) fine sandy loam, light olive brown (2.5Y 5/3) moist; weak, coarse and medium, subangular blocky structure; hard dry, very friable moist; common very fine roots; few fine white spots of lime; slight effervescence; moderately alkaline; clear, wavy boundary.

C2—34 to 60 inches, pale-yellow (5Y 7/3) very soft bedded sandstone, crushes to loamy fine sand, olive (5Y 5/3) moist; massive; slightly hard and hard in strata and brittle dry, very friable moist; slight effervescence; moderately alkaline.

The solum ranges from 20 to 34 inches in thickness. Depth to carbonates ranges from 10 to 30 inches. In some places the soil is noncalcareous. Depth to bedded sandstone in most places is 30 to 40 inches, but it ranges from 20 to 40 inches. The A horizon is grayish brown or light brownish gray. It is slightly acid or neutral and is 4 to 9 inches thick. The B horizon is brown, grayish-brown, or light yellowish-brown sandy loam or fine sandy loam. It is neutral or mildly alkaline. The structure of the B horizon is weak or moderate. The sedimentary beds in the C horizon are sandstone.

Rhame soils are associated with Desart, Fleak, Marmarth, Tusler, and Zeona soils. They lack the claypan B horizon of Desart soils. They have thicker A and B horizons than Fleak and Tusler soils. They are coarser textured than Marmarth soils and are finer textured than Zeona soils.

Rhame fine sandy loam, gently sloping (RnB).—This soil is on uplands. Slopes are 3 to 6 percent. The soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Toby and Tusler fine sand loams.

Runoff is medium. This soil is highly susceptible to soil blowing. Controlling soil blowing is a necessary part of good management.

Some areas of this soil are cultivated. Other areas remain in grass. This soil is suited to cultivated crops if good management practices are used. Capability unit IIIe–3; Sandy range site; windbreak suitability group 5.

Rhame-Fleak fine sandy loams, sloping (RoC).—The soils in this complex are on uplands. Slopes are 6 to 9 percent. The complex is 65 percent Rhame fine sandy loam, 20 percent Fleak and Tusler fine sandy loams and loamy fine sands, 5 percent Zeona loamy fine sand, and less than 10 percent other included soils. Rhame soils are in the middle positions on the landscape, and Fleak soils are on the crests. In places Tusler soils are between areas of Rhame and Fleak soils.

The profile of Rhame fine sandy loam is similar to that described as representative of the Rhame series, but the surface layer and subsoil are thinner.

The profile of Fleak fine sandy loam is similar to that described as representative of the Fleak series, but the surface layer and subsoil are thicker, and in places the surface layer is fine sandy loam.

Included with these soils in mapping are small areas of Toby fine sandy loam and areas of moderately eroded soils.

Runoff is medium. These soils are highly susceptible to soil blowing. Controlling soil blowing is a necessary part of good management.

These soils are used for crops and pasture. They are suited to cultivation if good management practices are used. Both soils in capability unit IVe–3; Rhame part in Sandy range site; windbreak suitability group 5. Fleak part in Shallow range site; windbreak suitability group 10.

Rhame-Fleak fine sandy loams, hilly (RoD).—The soils of this complex are on uplands. Slopes are mainly 9 to 12 percent but range from 9 to 15 percent. The complex is 55 percent Rhame fine sandy loam, 30 percent Fleak and Tusler loamy fine sands and fine sandy loams and 15 percent other included soils. Rhame soils are in the middle positions on the landscape, and Fleak soils are on the higher crests. In places Tusler soils are between areas of Fleak and Rhame soils.

The profile of Rhame fine sandy loam is similar to that described as representative of the Rhame series, but the surface layer and subsoil are thinner.

The profile of Fleak fine sandy loam is similar to that described as representative of the Fleak series, but the surface layer is fine sandy loam.

Included with these soils in mapping are small areas of Toby soils.

Runoff is rapid. The soils are highly susceptible to soil blowing. Susceptibility to soil blowing, moderate to very low available water capacity, and loss of organic matter are concerns of management. Management that maintains a good grass cover, organic-matter content, and fertility is needed.

These soils are used for crops and pasture. They are better suited to grasses than to most other crops because they are shallow, have moderate to very low available water capacity, and are steep. Both soils in capability unit VIe–Sy; Rhame part in Sandy range site; windbreak suitability group 7. Fleak part in Shallow range site; windbreak suitability group 10.

Rhoades Series

This series consists of deep and moderately deep, well-drained and moderately well drained, nearly level to sloping soils on terraces, fans, and uplands. These soils have a claypan subsoil. They formed in alluvium and material weathered from shale.

In a representative profile the surface layer is grayish-brown loam about 3 inches thick. The subsurface layer is light brownish-gray loam about 2 inches thick. The subsoil is about 19 inches thick. The upper part is extremely firm, grayish-brown silty clay. The middle part is extremely firm, grayish-brown silty clay that contains salt masses. The lower part is light olive-brown silty clay loam that contains salt masses. The underlying material is olive silty clay loam, about 11 inches thick, over soft shale sedimentary beds.

Permeability is very slow. Available water capacity and fertility are low. Organic-matter content is moderate. The slowly permeable subsoil restricts root penetration. Most of the roots that penetrate the subsoil are in the cracks of the claypan. High concentrations of salts in these soils restrict plant growth.

Most areas of these soils are in pasture or range. The native vegetation is mainly blue grama, threadleaf sedge, western wheatgrass, inland saltgrass, pricklypear, and sagebrush. Small areas that are associated with soils better suited to crops are tilled. If these soils are cultivated, the surface layer is dispersed and puddled (fig. 11). These soils are better suited to grasses than to most other crops. They are not suited to trees.

Representative profile of a Rhoades loam in an area of Rhoades-Absher complex, gently sloping, in native grass, 186 feet west and 840 feet south of the northeast corner of SE¼ sec. 34, T. 130 N., R. 104 W.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) loam, very dark grayish brown (2.5Y 3/2) moist; weak, coarse, crumb structure; soft dry, friable moist, slightly sticky and nonplastic wet; slightly acid; abrupt, smooth boundary.

A2—3 to 5 inches, light brownish-gray (2.5Y 6/2) loam, very dark grayish brown (2.5Y 3/2) moist; weak, thick and medium, platy structure; slightly hard dry, friable moist, slightly sticky and nonplastic wet; slightly acid; abrupt, smooth boundary.

Figure 11.—**Area of Rhoades soils intermingled with soils that are better suited to cultivation. Light-colored spots are dispersed and puddled areas of Rhoades soils.**

B21t—5 to 11 inches, grayish-brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; strong, coarse, columnar structure parting to strong, coarse and medium, blocky structure; extremely hard dry, extremely firm moist, sticky and very plastic wet; moderately alkaline; clear, wavy boundary.

B21cs—11 to 17 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong, coarse, prismatic structure parting to strong, coarse and medium, blocky structure; very hard dry, extremely firm moist, very sticky and very plastic wet; common crystalline salt masses; slight effervescence; strongly alkaline; gradual, wavy boundary.

B3cs—17 to 24 inches, light olive-brown (2.5Y 5/3) silty clay loam, olive brown (2.5Y 4/3) moist; moderate, coarse, prismatic structure parting to moderate, coarse and medium, angular blocky structure; hard dry, firm moist, sticky and plastic wet; common crystalline salt masses; violent effervescence; strongly alkaline; gradual, wavy boundary.

Cca—24 to 35 inches, olive (5Y 5/3) silty clay loam, olive (5Y 4/3) moist; weak, medium, angular blocky structure; extremely hard dry, firm moist, sticky and plastic wet; a few small concretions, yellowish brown (10YR 5/8) moist; violent effervescence; strongly alkaline; clear, wavy boundary.

IIC1—35 to 60 inches, olive (5Y 5/3) platy shale, olive brown (2.5Y 4/3) moist; extremely hard dry, slightly sticky and slightly plastic wet; slight effervescence; strongly alkaline.

The solum ranges from 16 to 30 inches in thickness. Visible salt is at a depth of 2 to 16 inches. Depth to platy shale in most places is 30 to 40 inches, but it ranges from 30 inches to more than 60 inches. The total thickness of the A horizon is 1 to 5 inches. The A horizon ranges from slightly acid to mildly alkaline. It is grayish-brown, dark grayish-brown, or gray fine sandy loam, loam, silt loam, clay loam, silty clay loam, or silty clay. The A2 horizon is coarser textured than the A1 horizon in places. The A2 horizon is indicated in some places by gray coating on the peds at the top of the B21t horizon. The B horizon is clay loam, silty clay loam, silty clay, or clay. The structure of the B2t horizon is moderate or strong. Columnar structure of the B2 horizon ranges in size from medium to coarse. Peds in the subsoil are coated with very dark grayish brown in places. Sand grains coat the sides of the columns in places. The sedimentary beds in the C horizon are soft shale. They are mottled in places.

Rhoades soils are associated with Absher, Belfield, Daglum, Heil, and Ladner soils. They have a darker colored A horizon when moist than Absher soils. They have a columnar B2t horizon that is lacking in Belfield soils. They are shallower to a claypan B horizon and to salts than Daglum soils. They are coarser textured than Ladner soils. They have better drainage than Heil soils.

Rhoades-Absher complex, nearly level (RrA).—The soils in this complex are on uplands. The complex is 40

to 50 percent Rhoades soils, 15 to 20 percent Absher soils, 10 to 15 percent Belfield soils, 5 to 10 percent Daglum soils, 20 percent Morton, Regent, Moreau, Reeder, and Amor soils, and 5 percent other included soils. Areas that are in native grasses have a pitted microrelief. The pitted areas are locally known as slick, scab, pan, or gumbo spots. These spots have little or no vegetation and absorb water slowly. In cultivated areas these spots are dispersed and puddled. In most places the spots are Rhoades soils that have lost the material in the surface layer through erosion. Rhoades soils are dominant in the eastern two-thirds of the county, and Absher soils are dominant in some western areas.

The profile of the Rhoades soils is similar to that described as representative of the Rhoades series, but the surface layer and subsoil are thicker, and in places the surface layer is finer or coarser textured.

The profile of the Absher soils is similar to that described as representative of the Absher series, but in places the surface layer is finer or coarser textured.

Included with these soils in mapping are small areas of Alluvial land, strongly saline, and Moreau, Arnegard, and Grail soils.

Runoff is slow to medium. Permeability is very slow, and water ponds in level areas. Controlled grazing is a necessary part of good management.

Very little of the acreage of the soils in this complex is cultivated. The soils are used for grazing, and they are better suited to grazing than to most other uses. Some areas are used for hay. Both soils in capability unit VIs–TC; Thin Claypan range site; windbreak suitability group 9.

Rhoades-Absher complex, gently sloping (RrB).—The soils in this complex are on uplands. Slopes are mainly 3 to 6 percent but range from 3 to 9 percent. The complex is 35 to 45 percent Rhoades soils, 15 to 20 percent Absher soils, 10 to 15 percent Belfield soils, 5 to 10 percent Daglum soils, 25 percent Morton, Regent, Moreau, Reeder, and Amor soils, and 5 percent other included soils. Most slopes are gentle. A few areas are strongly sloping. Areas in native grass have a pitted microrelief. The pitted areas are locally known as slick, scab, pan, or gumbo spots. These spots support little or no vegetation and absorb water slowly. In cultivated areas these spots are dispersed and puddled. In most places the spots are Rhoades soils that have lost material in the surface layer through erosion. Rhoades soils are dominant in the eastern two-thirds of the county, and Absher soils are dominant in some western areas.

The Rhoades soils have a profile similar to that described as representative of the Rhoades series, but in places the surface layer is finer or coarser textured.

The profile of the Absher soils is similar to that described as representative of the Absher series, but in places the surface layer is finer or coarser textured.

Included with this complex in mapping are small areas of Arnegard loam, Grail silt loam, and Grail soils, saline.

Runoff is medium to rapid. The hazard of water erosion is moderate to severe. Controlling grazing helps to control erosion.

Very little of the acreage of these soils is cultivated. Most areas are used for grazing, and the soils are better suited to grazing than to most crops. Some areas are used for hay. Capability unit VIs–TC; Thin Claypan range site; windbreak suitability group 9.

Rhoades complex, terrace (Rt).—The soils in this complex are on fans and terraces. Slopes range from 0 to 6 percent but are mainly 0 to 3 percent. The complex is about 60 percent Rhoades soils, 30 percent Belfield and Daglum soils, and 10 percent other included soils. Drainageways dissect the areas in places. Areas in native grass have a pitted microrelief. The pitted areas are locally known as slick, scab, pan, or gumbo spots. These support little or no vegetation and absorb water slowly. In cultivated areas these spots are dispersed and puddled. In most places the spots are Rhoades soils that have lost the material in the surface layer through erosion.

The profile of Rhoades soils is similar to the one described as representative of the Rhoades series, but it is deeper over soft bedrock.

Included with these soils in mapping are small areas of Alluvial land, strongly saline, and Shambo and Savage soils.

Runoff is slow in nearly level areas and medium in gently slopping areas. Permeability is very slow, and water ponds in the nearly level areas after heavy rains.

Very little of the acreage of these soils is cultivated. Most of the areas are used for grazing, and the soils are better suited to grazing than to most crops. Some areas are used for hay. Capability unit VIs–TC; Thin Claypan range site; windbreak suitability group 9.

Riverwash

Riverwash (Rw) consists of deposits mainly of fine sand but also of some silt, clay, and gravel. The areas are in narrow strips along the channels of the Little Missouri River and the North Fork of the Grand River. The areas are flooded and reworked by water each time the streams overflow.

Riverwash has no value for farming. It is subject to soil blowing because it supports few plants. Capability unit VIIIe; range site not assigned; windbreak suitability group 10.

Savage Series

This series consists of deep, well-drained, nearly level soils on fans, terraces, (fig. 12) and side slopes below higher areas. These soils formed in alluvium.

In a representative profile the surface layer is dark grayish-brown silty clay loam about 6 inches thick. The subsoil is firm silty clay about 22 inches thick. It is dark grayish brown to a depth of about 13 inches and grayish brown to a depth of about 28 inches. Below this is olive silty clay loam about 6 inches thick. Beneath this is olive and pale-olive silty clay, about 16 inches thick, underlain by grayish-brown silty clay.

Permeability is moderately slow. Available water capacity is high. Organic-matter content is moderate. Fertility is high. Tilth is fair to good, but these soils shrink and crack when dry.

These soils are used for crops, hay, and pasture. They are suited to cultivated crops, trees, and grasses common

Figure 12.—Savage silty clay loam on a broad terrace.

to the county. The native vegetation consists of green needlegrass, western wheatgrass, and blue grama. These soils are suited to irrigation.

Representative profile of Savage silty clay loam, nearly level, in a cultivated field, 635 feet south and 153 feet east of the northwest corner of SW¼ sec. 30, T. 129 N., R. 99 W.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure parting to moderate, medium and fine, crumb structure; slightly hard dry, friable moist, sticky and plastic wet; neutral; abrupt, smooth boundary.

B21t—6 to 13 inches, dark grayish-brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; very dark grayish brown (10YR 3/2) moist coats on all peds; moderate, coarse and medium, prismatic structure parting to moderate, coarse and medium, angular blocky and strong, fine and very fine, angular blocky structure; hard dry, firm moist, sticky and plastic wet; mildly alkaline; clear, smooth boundary.

B22t—13 to 22 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; very dark grayish brown (2.5Y 3/2) moist coats on the vertical surfaces and part of horizontal surfaces of peds; moderate, medium, prismatic structure parting to strong, medium and fine, angular blocky structure; very hard dry, firm moist, sticky and very plastic wet; moderately alkaline; gradual, wavy boundary.

B3—22 to 28 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak, medium to moderate, coarse and medium, angular blocky structure; very hard dry, firm moist, sticky and very plastic wet; violent effervescence; moderately alkaline; gradual, wavy boundary.

C1ca—28 to 34 inches, olive (5Y 5/3) silty clay loam, olive (5Y 4/3) moist; weak, medium, prismatic structure parting to moderate, coarse and medium, angular blocky structure; extremely hard dry, firm moist, sticky and plastic wet; violent effervescence; common masses of segregated lime; moderately alkaline; gradual, wavy boundary.

C2—34 to 41 inches, olive (5Y 5/3) silty clay, olive (5Y 4/3) moist; weak, medium, angular blocky structure; extremely hard dry, very firm moist, sticky and very plastic wet; strong effervescence; moderately alkaline; gradual, wavy boundary.

C3—41 to 50 inches, pale-olive (5Y 6/3) silty clay, olive (5Y 4/3) moist; weak, medium, angular blocky structure; extremely hard dry, very firm moist, sticky and very plastic wet; strong effervescence; moderately alkaline; gradual, wavy boundary.

C4—50 to 60 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak, medium, angular blocky structure; sticky and very plastic wet; violent effervescence; common nodules of segregated lime; moderately alkaline.

The solum ranges from 12 to 36 inches in thickness. Depth to carbonates ranges from 10 to 26 inches. Depth to sedimentary beds is more than 60 inches in most places, but it ranges from 40 to 60 inches. Some places have thin gravel lenses or a buried A horizon below a depth of 40 inches. The A horizon is dark grayish-brown or grayish-brown clay loam, silty clay loam, or silt loam. It is neutral to mildly alkaline and is 4 to 10 inches thick. The B2 horizon is grayish-brown, dark grayish-brown, or brown silty clay loam, silty clay, or clay. In some places gypsum salts are in the lower part of the B horizon. The B horizon has weak, moderate, or strong prismatic structure. Coats on surfaces of peds are thin films of darker colored clays and organic matter. The C horizon is loam, silt loam, or clay loam in some places.

Savage soils are associated with Cherry, Grail, and Lawther soils. They are darker colored than Cherry soils. They are dark to a shallower depth than Grail soils. They contain less clay in the B2 horizon than Lawther soils.

Savage silty clay loam, nearly level (ScA).—This soil is on fans, terraces, and side slopes below steeper areas. In a few places it is gently sloping. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Grail silty clay loam, Korchea clay loam, wet variant, Rhoades silty clay loam, and Shambo silt loam. Also included are 107 acres of Savage silt loam.

Runoff is slow to medium, and the hazard of erosion is slight. The main concerns of management are conserving moisture and maintaining fertility.

Most areas of this soil are cultivated. Only a few areas remain in grasses. The soil is well suited to cultivated crops. It is suited to irrigation. Capability unit IIc–7; Clayey range site; windbreak suitability group 3.

Savage-Rhoades silty clay loams, nearly level (ScA).—The soils in this complex are on fans and terraces. The complex is 60 to 85 percent Savage silty clay loam, 5 to 35 percent Rhoades clay loam, 15 to 25 percent Daglum and Belfield clay loams and silty clay loams, and 5 to 15 percent other soils. Also included are a few small

areas that are gently sloping. Areas in native grass have a pitted microrelief. The pitted areas are locally known as slick, scab, pan, or gumbo spots, support little or no vegetation, and absorb water slowly. In cultivated areas these spots are dispersed and puddled. In most places the spots are Rhoades soils that have lost material in the surface layer through erosion.

The profile of Savage silty clay loam is similar to that described as representative of the Savage series, but the content of salt in the lower part of the subsoil is higher.

The profile of Rhoades silty clay loam is similar to that described as representative of the Rhoades series, but the surface layer is silty clay loam.

Runoff is slow to medium. After heavy rains water ponds on these soils for short periods. Available water capacity is moderate to low where Rhoades soils occur near Daglum soils. Crops are thus unfavorably affected during years of below-normal rainfall. Concerns of management are conserving moisture, improving tilth, and maintaining organic-matter content and fertility.

Most areas of this complex are cultivated. Other areas remain in grasses. These soils are suited to most crops commonly grown in the county. They are poorly suited to corn. Crops emerge and develop slowly in the dispersed areas. Both soils in capability unit IIIs–P; Savage part in Clayey range site; windbreak suitability group 3. Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Searing Series

This series consists of moderately deep, well-drained, gently sloping to sloping soils on uplands. These soils formed in material weathered from shale and porcellanite and clinker from burned out coal veins. They are underlain by scoria.

In a respresentative profile the surface layer is brown loam about 6 inches thick. The subsoil is friable loam about 10 inches thick. The upper part is dark reddish gray, and the lower part is reddish brown. The underlying material is reddish-yellow loam about 12 inches thick and is underlain by porcellanite (scoria) beds containing some clinkers.

Permeability and organic-matter content are moderate. Available water capacity is low to moderate. Fertility is medium.

Most areas of these soils are cultivated, except where they occur as small areas in the Bradenburg-Cabba complex. Other areas remain in grasses, and green needlegrass, western wheatgrass, and blue grama are the principal species. These soils are suited to cultivated crops and grasses commonly grown in the county. They are poorly suited to trees.

Representative profile of Searing loam, gently sloping, in a cultivated field, 805 feet east and 45 feet south of the northwest corner of SW¼ sec. 33, T. 131 N., R. 99 W.:

Ap—0 to 6 inches, brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak, medium, subangular blocky structure parting to moderate, medium and fine, crumb structure; slightly hard dry, friable wet; many roots; many fine pores; neutral; abrupt, smooth boundary.

B21—6 to 12 inches, dark reddish-gray (5YR 4/2) loam, dark reddish brown (5YR 3/2) moist; moderate, coarse, prismatic structure parting to moderate, coarse and medium, angular blocky structure; hard dry, friable wet; common roots; many fine pores; thin patchy clay films of dark brown (7.5YR 3/2) moist; neutral; clear, wavy boundary.

B22—12 to 16 inches, reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; weak, coarse, prismatic structure parting to moderate, coarse and medium, angular blocky structure; hard dry, friable wet; common fine roots and pores; few porcellanite chips; mildly alkaline; clear, wavy boundary.

C1—16 to 23 inches, reddish-yellow (5YR 6/6) loam, yellowish red (5YR 4/6) moist; weak, coarse and medium, subangular blocky structure; slightly hard dry, friable wet; few roots; common fine pores; 5 to 20 percent friable wet; porcellanite chips; strong effervescence; moderately alkaline; clear, wavy boundary.

C2—23 to 28 inches, reddish-yellow (5YR 6/6) loam, yellowish red (5YR 5/6) moist; weak, fine, subangular blocky structure; slightly hard dry, friable wet; 50 percent partly weathered hard porcellanite chips; strong effervescence; moderately alkaline; clear, wavy boundary.

IIC3—28 to 60 inches, yellowish-red (5YR 5/6) hard beds of platy porcellanite and clinkers containing some loamy material between layers; strong effervescence; moderately alkaline.

The solum ranges from 10 to 24 inches in thickness. Depth to carbonates ranges from 8 to 22 inches. Some places have a Cca horizon. Depth to porcellanite typically is 20 to 30 inches, but it ranges from 20 to 40 inches. In some places porcellanite fragments are throughout. The A horizon is brown, dark grayish-brown, dark-brown, or reddish-brown loam, silt loam, or clay loam. It ranges from neutral to mildly alkaline and is 4 to 8 inches thick. The B horizon is reddish-yellow, dark reddish-gray, and reddish-brown loam, silt loam, and clay loam. It ranges from neutral to moderately alkaline. The prismatic structure of the B2 horizon is weak to strong. In some places the porcellanite beds have noncalcareous layers.

Searing soils are associated with Brandenburg and Shambo soils. They have a B horizon that Brandenburg soils lack, and they are deeper to porcellanite beds. They differ from Shambo soils in having porcellanite beds at a moderate depth.

Searing loam, gently sloping (SeB).—This soil is on uplands. Slopes are 3 to 6 percent in most places but range from 0 to 6 percent. In places numerous porcellanite fragments are on the surface. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Brandenburg, Reeder, Rhoades, and Shambo loams.

Runoff is medium, and the hazards of water erosion and soil blowing are slight to moderate. The main concerns of management are controlling water erosion and soil blowing and conserving moisture.

Most areas of this soil are cultivated, but some areas remain in grasses. This soil is suited to cultivated crops if good management practices are used. Capability unit IIIes–5; Silty range site; windbreak suitability group 6.

Searing loam, sloping (SeC).—This soil is on uplands. Slopes are 6 to 9 percent. In places numerous porcellanite fragments are on the surface. This soil is similar to the one described as representative of the series, but it has a thinner solum.

Included with this soil in mapping are small areas of Brandenburg, Reeder, and Shambo loams.

Runoff is medium, and the hazard of water erosion is moderate. Susceptibility to soil blowing is moderate. The main needs of management are controlling water erosion and soil blowing and conserving moisture.

Some areas of this soil are cultivated, but other areas remain in grass. This soil is suited to cultivated crops commonly grown in the county if good management practices are used. Capability unit IIIes–5; Silty range site; windbreak suitability group 6.

Sham Series

This series consists of deep, well-drained, gently sloping to sloping soils on fans and lower slopes adjacent to steep and hilly areas. These soils formed in sediment eroded from the steeper Cabbart soils and from Rough broken land.

In a representative profile the surface layer is grayish-brown loam about 4 inches thick. Below is friable, light brownish-gray loam about 6 inches thick. The underlying material is light brownish-gray fine sandy loam about 4 inches thick over stratified loam, silt loam, and very fine sandy loam.

Permeability is slow. Available water capacity is moderate. Organic-matter content is low. Fertility is medium. Water erosion is a severe hazard if the soils are overgrazed or cultivated.

These soils are used mainly for grazing. They are not suited to cultivation. Native vegetation includes needle-and-thread, western wheatgrass, blue grama, sagebrush, and pricklypear. These soils are not suited to trees.

Representative profile of a Sham loam in an area of Sham soils and Gullied land, in native grass, 400 feet east and 430 feet north of the southwest corner of NW¼ sec. 8, T. 132 N., R. 105 W.:

A11—0 to 4 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, medium and fine, granular structure and weak, fine, platy structure; hard dry, friable moist; many roots; moderately alkaline; clear, wavy boundary.

A12—4 to 10 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, medium and fine, subangular blocky structure; hard dry, friable moist; common roots; few pores; slight effervescence; moderately alkaline; clear, wavy boundary.

C1—10 to 14 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; massive, stratified; very hard dry, friable moist; few roots; few pores; strong effervescence; strongly alkaline; clear, wavy boundary.

C2—14 to 60 inches, light olive-gray (5Y 6/2) loam, silt loam, and very fine sandy loam, stratified with lenses of fine sandy loam, olive gray (5Y 5/2) moist; massive; very hard to extremely hard dry, friable moist; very few fine roots in upper part; few lime spots; strong effervescence; strongly alkaline.

Texture of the A horizon is mainly fine sandy loam or loam. Below the A horizon it is stratified fine sandy loam, loam, very fine sandy loam, and clay loam. The layers range from ¼ inch to 4 inches in thickness. Depth to carbonates ranges from 0 to 10 inches. Buried layers and gravel lenses or fragments are in some places. The A horizon is grayish-brown or light brownish-gray loam, silt loam, or very fine sandy loam. It ranges from 3 to 10 inches in thickness. The C horizon is moderately alkaline or strongly alkaline.

Sham soils are associated with Patent soils. They are coarser textured and more alkaline than Patent soils.

Sham soils and Gullied land (Sg).—The soils in this mapping unit are on long fans and slopes below higher areas. Slopes are 3 to 9 percent. Some areas are all Sham soils or all Gullied land. Other areas are part Sham soils and part Gullied land. The surface layer is mainly loam. The areas are dissected by gullies or washes. The gullies are from 1 to 15 feet deep and as much as 100 feet wide. About one-half of some areas are eroded or gullied. Many islands have the original fan level. In places the soil has washed away, exposing shale and sandstone outcrops.

The Sham soils have the profile described as representative of the Sham series.

Included in mapping are areas of Patent loam. Also included are small areas of Cabbart loam and Alluvial land, strongly saline.

Runoff is medium to rapid. The need of management is controlling water erosion. Controlled grazing is a necessary part of good management.

Sham soils and Gullied land are used for grazing. None of the areas are suited to cultivation. Gullies in places make accessibility difficult for grazing animals. Both soils in capability unit VIIs–Cp; Sham part in Claypan range site; windbreak suitability group 10. Gullied land part, range site not assigned; windbreak suitability group 10.

Shambo Series

This series consists of deep, well-drained, nearly level to gently sloping soils on toe slopes, fans, terraces, and side slopes below higher areas. These soils formed in alluvium.

In a representative profile the surface layer is dark grayish-brown loam about 5 inches thick. The subsoil is friable loam about 17 inches thick. The upper part is dark grayish brown, the middle part is grayish brown, and the lower part is grayish brown and light brownish gray. Segregated carbonates are evident in the lower part. The underlying material is light yellowish-brown loam about 10 inches thick over stratified alluvium of loam and gravelly sandy loam. The alluvium is light olive brown, light yellowish brown, and light brownish gray.

Permeability and organic-matter content are moderate. Available water capacity and fertility are high. Tilth is good.

These soils are used for crops, hay, and pasture. They are mainly used for crops. They are suited to cultivated crops, trees, and grasses commonly grown in the county. Native vegetation includes green needlegrass, western wheatgrass, and blue grama. Some areas are suited to irrigation.

Representative profile of Shambo loam, nearly level, in native grass, 1,716 feet south and 1,420 west of northeast corner sec. 19, T. 129 N., R. 100 W.:

A1—0 to 5 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure and moderate, fine, granular structure; slightly hard dry, friable moist; many roots and fine pores; neutral; clear, smooth boundary.

B21—5 to 10 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure parting to moderate, medium, angular blocky structure; hard dry, friable moist; many roots; common medium and fine pores; neutral; clear, smooth boundary.

B22—10 to 16 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate, medium, prismatic structure parting to moderate, medium, sub-

angular blocky structure; hard dry, friable moist; common fine roots; common fine pores; thin, very dark grayish-brown (10YR 3/2) moist; organic films on faces of prisms; neutral; clear, wavy boundary.

B23—16 to 19 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky structure; hard dry, friable moist; few roots; common fine pores; few soft lime masses; slight effervescence; moderately alkaline; clear, wavy boundary.

B3ca—19 to 22 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky structure; hard dry, friable moist; few fine roots and pores; violent effervescence; many soft lime accumulations; moderately alkaline; clear, wavy boundary.

C1ca—22 to 32 inches, light yellowish-brown (2.5Y 6/3) loam, light olive brown (2.5Y 5/3) moist; weak, medium, subangular blocky structure; hard dry, friable moist; few fine roots; many lime accumulations; violent effervescence; moderately alkaline; gradual boundary.

C2—32 to 46 inches, light olive-brown and light yellowish-brown (2.5Y 5/3 and 6/3) loam, olive brown and light olive brown (2.5Y 4/3 and 5/3) moist; massive, stratified; few fine roots; strong effervescence; moderately alkaline; clear, wavy boundary.

IIC3—46 to 60 inches, light brownish-gray (2.5Y 6/2) gravelly sandy loam, grayish brown (2.5Y 5/2) moist; single grain; slight effervescence; moderately alkaline.

The solum ranges from 18 to 42 inches in thickness. Depth to carbonates generally is 12 inches, but it ranges from 10 to 28 inches. Depth to sedimentary beds in most places is more than 60 inches but is 40 to 60 inches in places. Gravel lenses or a buried A horizon are below a depth of 40 inches in some places. The A1 horizon is dark grayish-brown or grayish-brown loam, silt loam, or clay loam. It is slightly acid or neutral and is 4 to 10 inches thick. The B horizon is loam, silt loam, or clay loam. It ranges from neutral to moderately alkaline. The structure of the B2 horizon is moderate or strong. The C horizon ranges from fine sandy loam to silty clay but average loam. In places the lower part of the subsoil and the substratum contain 5 to 40 percent porcellanite fragments.

Shambo soils are associated with Arnegard, Amor, Belfield, Reeder, and Stady soils. Shambo soils differ from Arnegard soils in being dark colored to a shallower depth. They lack the sedimentary beds within a depth of 40 inches that are characteristic of Amor and Reeder soils. They are coarser textured and lack the lighter colored A and B horizons of Belfield soils. They differ from Stady soils in having little or no gravel or sand to a depth of 40 inches.

Shambo loam, nearly level (ShA).—This soil is on fans and terraces. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Arnegard loam, Korchea loam, and Korchea clay loam, wet variant. Also included are a few areas of this soil where the surface layer is clay loam and the subsoil is finer textured than is typical.

Runoff is slow to medium, and the hazard of erosion is slight. The main needs of management are conserving moisture and maintaining fertility.

Most areas of this soil are cultivated. Only a few scattered areas remain in native grasses. This soil is well suited to cultivated crops. Capability unit IIc–6; Silty range site; windbreak suitability group 3.

Shambo loam, gently sloping (ShB).—This soil is on fans and terraces. Slopes are mainly 3 to 6 percent but range from 3 to 9 percent. This soil has a profile similar to the one described as representative of the series, but it has a thinner surface layer and subsoil.

Included with this soil in mapping are small areas of Arnegard loam, Tally fine sandy loam and a few areas where the surface layer is clay loam.

Runoff is medium. The hazard of water erosion is slight to moderate. The main needs of management are controlling water erosion and conserving moisture.

Most areas of this soil are cultivated, but some areas remain in grasses. This soil is suited to cultivation if good management practices are used. Capability unit IIe–6; Silty range site; windbreak suitability group 3.

Shambo-Arnegard loams, nearly level (S1A).—The soils in this complex are in swales and on long broad fans. The complex is about 45 percent Shambo loam and silt loam, 30 percent Arnegard loam and silt loam, 15 percent included Searing loam and silt loam, and 10 percent included soils. In places porcellanite fragments are on the surface. These soils formed in material washed from steeper areas.

The profile of Shambo loam is similar to the profile described as representative of the Shambo series, but as much as 40 percent porcellanite fragments are in the lower part of the subsoil and in the substratum. Also, in places the surface layer is silt loam or is redder than is typical, and in others it is darker and thicker.

The profile of Arnegard loam is similar to that described as representative of the Arnegard series, but some porcellanite fragments are in the substratum and in some places the surface layer is silt loam.

Included with these soils in mapping are small areas of Amor and Reeder loams.

Runoff is medium. These soils are resistant to soil blowing. Management is needed to maintain organic-matter content and fertility.

Most areas of these soils are cultivated, but some areas remain in grasses. These soils are well suited to cultivated crops. Both soils in Capability unit IIc–6; Shambo part in Silty range site; windbreak suitability group 3. Arnegard part in Overflow range site; windbreak suitability group 1.

Shambo-Arnegard loams, gently sloping (S1B).—The soils in this complex are on fans and in swales. Slopes range from 3 to 9 percent but most are 3 to 6 percent. The complex is 55 percent Shambo loam or silt loam, gently sloping, 20 percent Arnegard loam or silt loam, 15 percent Searing loam, and 10 percent other soils. These soils formed in material washed from steeper areas.

The profile of Shambo loam is similar to that described as representative of the Shambo series, but as much as 45 percent porcellanite fragments is in the substratum. Also, in places the surface layer is silt loam or is redder than typical, and in others it is darker and thicker.

The profile of Arnegard loam is similar to that described as representative of the Arnegard series, but some porcellanite fragments are in the substratum and in some places the surface layer is silt loam.

Included with this complex in mapping are small areas of Amor and Reeder loams. Also included with this unit are 143 acres where the dominant soil is Arnegard loam, sloping.

Runoff is medium. The hazard of water erosion is slight to moderate. The main concerns of management are controlling water erosion and conserving moisture.

Most areas of this complex are cultivated. Other areas remain in grass. These soils are suited to cultivation if protective measures are used. Both soils in capability unit IIe–6; Silty range site; Shambo part in windbreak suitability group 3. Arnegard part in windbreak suitability group 1.

Shambo-Belfield-Rhoades loams, nearly level (SmA).—The soils in this complex are on fans and terraces. The complex is 55 to 80 percent Shambo loam, 20 to 40 percent Belfield loam or silt loam, 5 to 35 percent Rhoades loam, 5 to 15 percent Daglum loam or silt loam, and 15 to 20 percent other soils. Areas in native grasses have a pitted microrelief. The pitted areas, locally known as slick, scab, pan, or gumbo spots, support little or no vegetation and absorb water slowly. In cultivated areas these spots are dispersed and puddled. In most places the spots are Rhoades soils that have lost material in the surface layer through erosion.

The Shambo loam has a profile similar to that described as representative of the Shambo series, but the salt content in the lower part of the subsoil is higher.

The profile of Belfield loam is similar to the profile described as representative of the Belfield series, but the surface layer is loam.

The profile of Rhoades loam is similar to the profile described as representative of the Rhoades series.

Included with the soils in this complex in mapping are small areas of Grail soils, saline, and Korchea clay loam, wet variant. Also included are 214 acres of soils that have slopes of 3 to 6 percent.

Runoff is slow. Available water capacity is moderate to low where Rhoades soils occur near Daglum soils. Needs of management are improving tilth, conserving moisture, and maintaining organic-matter content and fertility.

Many areas of these soils are cultivated. Other areas remain in grasses. The soils are suited to most crops commonly grown in the county if good management practices are used. The soils are poorly suited to corn. Crops emerge and develop slowly in the dispersed areas. All soils in Capability unit IIIs–P; Shambo part in Silty range site; windbreak suitability group 3. Belfield part in Clayey range site; windbreak suitability group 4. Rhoades part in Thin Claypan range site; windbreak suitability group 9.

Stady Series

This series consists of well-drained, nearly level to gently sloping soils that are moderately deep over sand and gravel. These soils formed in alluvium. They are on terraces and fans.

In a representative profile the surface layer is dark grayish-brown loam about 7 inches thick. The subsoil is 17 inches thick. The upper part is brown to dark-brown loam. The middle and lower parts are brown loam. The underlying material is light brownish-gray gravelly loam about 3 inches thick over sand and gravel.

Permeability is moderate above the gravelly substratum and very rapid in the substratum. Available water capacity is low. Organic-matter content is moderate. Fertility is medium. Tilth is good.

Most areas of these soils are used for crops, but some areas remain in native grasses, and green needlegrass, western wheatgrass, and blue grama are the principal species. Stady soils are suited to cultivated crops.

Representative profile of Stady loam, nearly level, in a cultivated field, 674 feet east and 330 feet south of northwest corner of sec. 4, T. 132 N., R. 100 W.:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak, fine, crumb structure; slightly hard dry, friable moist, slightly sticky and slightly plastic wet; neutral; abrupt, smooth boundary.

B21—7 to 13 inches, brown to dark-brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; faces of peds coated very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure parting to moderate, medium, angular blocky structure; hard dry, friable moist, slightly sticky and slightly plastic wet; neutral; clear, smooth boundary.

B22—13 to 20 inches, brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; partial coats of very dark grayish brown (10YR 3/2) on the vertical surfaces of peds; moderate, medium, prismatic structure parting to moderate, medium, angular blocky structure; hard dry, friable moist, slightly sticky and slightly plastic wet; mildly alkaline; clear, wavy boundary.

B3—20 to 24 inches, brown (10YR 5/3) loam, dark grayish brown (10YR 4/2) moist; weak, medium, prismatic structure parting to moderate, coarse and medium, angular blocky structure; hard dry, friable moist, slightly sticky and slightly plastic wet; mildly alkaline; irregular boundary.

C1ca—24 to 27 inches, light brownish-gray (2.5Y 6/2) gravelly loam, dark grayish brown (2.5Y 4/2) moist; moderate, medium, angular blocky structure; hard dry, friable moist, slightly sticky and slightly plastic wet; violent effervescence; moderately alkaline; irregular boundary.

IIC2—27 to 31 inches, light brownish-gray (2.5Y 6/2) sand and gravel, dark grayish brown (2.5Y 4/2) moist; massive; violent effervescence; lime crusts on pebbles; moderately alkaline; clear, wavy boundary.

IIC3—31 to 60 inches, light brownish-gray (2.5Y 6/2) sand and gravel, dark grayish brown (2.5Y 4/2) moist; massive; strong effervescence; lime crusts on pebbles; moderately alkaline.

The solum ranges from 16 to 34 inches in thickness. Depth to carbonates ranges from 15 to 25 inches. Depth to gravel or sand typically is 20 to 30 inches, but it ranges from 20 to 40 inches. The A horizon is grayish-brown or dark grayish-brown loam, silt loam, or clay loam. It ranges from slightly acid to mildly alkaline and is 4 to 8 inches thick. The B horizon is dark-brown, brown, or grayish-brown loam or silt loam. The structure of the B2 horizon is moderate or strong. A calcareous gravel and sand layer is lacking in some places. The C horizon is gravel, stratified gravel and sand, loamy gravel, or sand and gravel.

Stady soils are associated with Lehr, Manning, Shambo, and Wabek soils. They are deeper over gravel and sand than Lehr soils. They are finer textured above the gravel than Manning soils. They differ from Shambo soils in having gravel and sand at a depth of 20 to 40 inches. They have a B horizon that is lacking in Wabek soils, and they are deeper over gravel and sand.

Stady loam, nearly level (SnA).—This soil is on terraces and fans. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Manning fine sandy loam and Shambo loam.

Runoff is slow. A large part of the rainfall is absorbed by the soil. This soil is moderately susceptible to soil blowing. Controlling soil blowing, conserving moisture, and maintaining organic-matter content and fertility are the main needs of management.

Most areas of this soil are cultivated, but some areas remain in grasses. This soil is suited to cultivated crops if good management practices are used. A few small areas are mined for gravel. This soil is suited to irrigation. Capability unit IIIs–5; Silty range site; windbreak suitability group 6.

Stady-Lehr loams, gently sloping (SrB).—The soils in this complex are on terraces and fans. Slopes are 3 to 6 percent. The complex is about 70 percent Stady loam, 15 percent Lehr loam, and 15 percent other soils. Stady soils are deeper over gravel than Lehr soils. Lehr soils are commonly near the edge of or on slight rises on terraces.

The profile of Stady loam is similar to that described as representative of the Stady series, but the surface layer and subsoil are thinner.

The profile of Lehr loam is similar to that described as representative of the Lehr series.

Included with these soils in mapping are small areas of Manning fine sandy loam and Shambo and Wabek loams.

Runoff is medium. These soils are susceptible to soil blowing. Controlling soil blowing, conserving moisture, and maintaining organic-matter content and fertility are the main needs of management.

Most areas of these soils are cultivated, but some areas remain in grasses. These soils are suited to cultivated crops if good management practices are used. A few scattered areas are mined for gravel. Both soils in capability unit IIIes–5; Stady part in Silty range site; windbreak suitability group 6. Lehr part in Shallow to Gravel range site; windbreak suitability group 6.

Stady-Shambo loams, nearly level (SsA).—The soils in this complex are on terraces and fans. The complex is about 60 percent Stady loam, 25 percent Shambo loam, and 15 percent other soils. Stady soils are shallower to gravel and sand than Shambo soils.

The profile of the Stady loam is similar to the profile described as representative of the Stady series.

The profile of the Shambo loam is similar to the profile described as representative of the Shambo series, but gravel or sand is at a depth of 40 to 60 inches.

Included with these soils in mapping are small areas of Manning fine sandy loam and Belfield loam.

Runoff is medium. A large part of the rainfall is absorbed by the soils. The soils are moderately susceptible to soil blowing. Controlling soil blowing, conserving moisture, and maintaining organic-matter content and fertility are the main needs of management.

Most areas of these soils are cultivated, but some areas remain in grasses. These soils are suited to cultivated crops if good management practices are used. A few small areas are mined for gravel. Both soils in capability unit IIe–5; Silty range site; Stady part in windbreak suitability group 6. Shambo part in windbreak suitability group 3.

Straw Series

This series consists of deep, well-drained, level, nearly level, and gently sloping soils on terraces and fans. These soils formed in alluvium.

In a representative profile the surface layer is dark grayish-brown loam about 7 inches thick. The subsoil is friable, dark grayish-brown loam about 14 inches thick. Below is grayish-brown loam about 16 inches thick. The underlying material is dark grayish-brown and grayish-brown loam.

Permeability is moderate. Available water capacity, organic-matter content, and fertility are high. Tilth is good.

Straw soils are used for crops, hay, and pasture. Native vegetation includes green needlegrass, western wheatgrass, and blue grama. The soils are suited to cultivated crops, trees, and grasses that are common in the county. They are suited to irrigation.

Representative profile of a Straw loam, in an area of Korchea-Straw complex, in native grass, 210 feet east and 885 feet north of southwest corner of NW¼ sec. 36, T. 129 N., R. 100 W.:

A1—0 to 7 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium and fine, subangular blocky structure and moderate, medium and fine, crumb structure; friable moist, slightly sticky and slightly plastic wet; abrupt, smooth boundary.

B21—7 to 12 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure parting to moderate, medium and fine, angular blocky structure; friable moist, slightly sticky and slightly plastic wet; neutral; abrupt, smooth boundary.

B22—12 to 21 inches, dark grayish-brown (10YR 4/2) loam, very dark gray (10YR 3/1) moist; moderate, medium, prismatic structure parting to moderate, medium and fine, angular blocky structure; friable moist, slightly sticky and slightly plastic wet; slight effervescence; mildly alkaline; abrupt, smooth boundary.

Cca—21 to 37 inches, grayish-brown (2.5Y 5/2) moist, loam; moderate, medium, prismatic structure parting to weak, coarse and medium, angular blocky structure and weak, medium, platy structure; friable moist, slightly sticky and slightly plastic wet; violent effervescence; many segregations of lime; moderately alkaline; clear, wavy boundary.

Ab3—37 to 49 inches, dark grayish brown (2.5Y 4/2 & 3/2), moist, loam; massive; friable moist, slightly sticky and slightly plastic wet; strong effervescence; moderately alkaline; clear, wavy boundary.

C1—49 to 60 inches, grayish brown (2.5Y 5/2) moist, loam; friable moist, slightly sticky and slightly plastic wet; strong effervescence; moderately alkaline.

The solum ranges from 14 to 24 inches in thickness. Carbonates commonly are at a depth of more than 10 inches. In some places there are no segregated carbonates; others have segregated carbonates in the B horizon. Depth to sedimentary beds in most places is more than 60 inches, but it ranges from 40 to 60 inches. Thin sand or gravel lenses are in some places. The A horizon is loam, silt loam, clay loam, or silty clay loam. It ranges from slightly acid to mildly alkaline and is 4 to 15 inches thick. The B horizon is dark grayish-brown, grayish-brown, or dark-gray loam, silt loam, or silty clay loam. The structure of the B horizon is weak or moderate. The texture of the C horizon ranges from fine sandy loam to silty clay loam, but it generally is loam.

Straw soils are associated with Havre, Korchea, and Velva soils. They are darker colored than Havre soils. They are darker colored to a greater depth than Korchea soils. They are finer textured than Velva soils.

Tally Series

This series consists of deep, well-drained, nearly level to sloping soils on fans, terraces, and side slopes below higher areas. These soils formed in alluvium.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 8 inches thick. The subsoil is very friable fine sandy loam about 12 inches thick. The upper part is dark brown and brown and the lower part is light brownish gray. Below is light brownish-gray fine sandy loam about 16 inches thick. This is underlain by grayish-brown, light brownish-gray and light grayish-brown sandy loam and fine sandy loam.

Permeability is moderately rapid. Available water capacity and organic-matter content are moderate. Fertility is medium. Tilth is good. Soil blowing is a hazard.

These soils are used for crops, hay, and pasture. Native grasses include needle-and-thread, prairie sandreed, and threadleaf sedge. The soils are suited to cultivated crops, trees, and grasses that are common in the county. Some areas are suited to irrigation.

Representative profile of a Tally fine sandy loam in an area of Tally-Parshall fine sandy loams, nearly level, in a cultivated field, 758 feet south and 380 feet west of the northeast corner of sec. 27, T. 131 N., R. 100 W.:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium and fine, crumb structure; soft dry, very friable moist, slightly sticky and nonplastic wet; neutral; abrupt, smooth boundary.

B21—8 to 14 inches, dark-brown to brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak, coarse, prismatic structure parting to weak, coarse and medium, subangular blocky structure; very friable moist, slightly sticky and nonplastic wet; mildly alkaline; clear, smooth boundary.

B22—14 to 17 inches, brown (10YR 5/3) fine sandy loam, dark brown to brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to weak, coarse and medium, subangular blocky structure; very friable moist, slightly sticky and nonplastic wet; mildly alkaline; clear, smooth boundary.

B23—17 to 20 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure parting to weak, coarse and medium, subangular blocky structure; very friable moist, slightly sticky and nonplastic wet; slight effervescence; mildly alkaline; gradual, wavy boundary.

C1—20 to 27 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, subangular blocky structure; very friable moist, slightly sticky and nonplastic wet; strongly calcareous; moderately alkaline; gradual, wavy boundary.

C2ca—27 to 36 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive; very friable moist, slightly sticky and nonplastic wet; violent effervescence; common segregations of nodular lime; moderately alkaline; gradual, boundary.

C3—36 to 50 inches, grayish-brown and light brownish-gray (2.5Y 5/2 and 6/2) sandy loam, dark grayish brown and very dark grayish brown (2.5Y 3/2 and 4/2) moist; massive; friable moist, slightly sticky and plastic wet; strong effervescence; moderately alkaline; gradual, wavy boundary.

C4—50 to 60 inches, light grayish-brown (2.5Y 6/2) moist fine sandy loam; slightly sticky and slightly plastic wet; strong effervescence; moderately alkaline.

The solum ranges from 16 to 40 inches in thickness. Depth to carbonates in most places is more than 14 inches, but it ranges from 12 to 28 inches. Depth to sedimentary beds in most places is more than 60 inches, but it ranges from 40 to 60 inches. Gravel lenses or a buried A horizon are below a depth of 40 inches in some places. The A horizon is dark grayish-brown or grayish-brown sandy loam, fine sandy loam, or loam. It is slightly acid or neutral and is 4 to 12 inches thick. The B horizon is light brownish-gray, grayish-brown, and dark grayish-brown sandy loam or fine sandy loam. It has weak or moderate structure. The C horizon ranges from loamy fine sand to loam, but it generally is fine sandy loam.

Tally soils are associated with Desart, Lefor, Parshall, and Vebar soils. Tally soils lack the claypan B horizon of Desart soils. They have a coarser textured B horizon than Lefor soils. They are dark colored to a shallower depth than Parshall soils. They lack soft bedded sandstone within a depth of 40 inches that is characteristic of Vebar soils.

Tally fine sandy loam, gently sloping (TaB).—This soil is on terraces and fans. Slopes are 3 to 6 percent. This soil has a profile similar to the one described as representative of the series, but the surface layer and subsoil are thinner.

Included with this soil in mapping are small areas of Ekalaka, Manning, and Parshall fine sandy loams. Also included are about 100 acres where the texture in the lower part of the subsoil and in the substratum is loam.

Runoff is medium. This soil is highly susceptible to soil blowing. Controlling soil blowing is a necessary part of good management.

Most areas of this soil is cultivated, but some areas remain in grasses. This soil is suited to crops commonly grown in the county if good management practices are used. This soil is suited to irrigation. Capability unit IIIe–3; Sandy range site; windbreak suitability group 5.

Tally fine sandy loam, sloping (TaC).—This soil is on terraces and side slopes below higher areas. Most slopes are 6 to 9 percent, but slopes range from 6 to 12 percent. This soil has a profile similar to the one described as representative of the series, but it has a thinner surface layer and subsoil.

Included with this soil in mapping are small areas of Parshall fine sandy loam and Telfer loamy fine sand.

Runoff is medium, and the hazard of water erosion is moderate. This soil is highly susceptible to soil blowing. Controlling soil blowing is a necessary part of good management.

Some areas of this soil are cultivated. Other areas remain in grasses. This soil is suited to cultivation if good management practices are used. It is better suited to grasses than to most other crops. Capability unit IVe–3; Sandy range site; windbreak suitability group 5.

Tally-Parshall fine sandy loams, nearly level (TdA).—The soils in this complex are on terraces and fans. The complex is about 65 percent Tally fine sandy loam, 20 percent Parshall fine sandy loam, and 15 percent other soils. Tally soils are dark colored to a shallower depth than Parshall soils.

Tally fine sandy loam has the profile described as representative of the Tally series.

The profile of Parshall fine sandy loam is similar to that described as representative of the Parshall series.

Included with these soils in mapping are small areas of Ekalaka, Manning, and Vebar fine sandy loams.

Runoff is slow to medium. These soils are highly susceptible to soil blowing. Controlling soil blowing is a necessary part of good management.

Most areas of these soils are cultivated, but some areas remain in grasses. These soils are suited to cultivation if good management practices are used. They are suited to irrigation. Both soils in capability unit IIIe–3; Sandy range site; Tally part in windbreak suitability group 5. Parshall part in windbreak suitability group 1.

Telfer Series

This series consists of deep, excessively drained, nearly level to sloping soils on uplands. These soils formed in alluvium weathered from sandstone and eolian sands.

In a representative profile the surface layer is dark grayish-brown loamy fine sand about 12 inches thick. The underlying material is light olive-brown, light yellowish-brown, light-gray, and light brownish-gray loamy fine sand about 42 inches thick over sedimentary beds of soft sandstone.

Permeability is rapid. Available water capacity is low. Organic-matter content is moderate. Fertility is low. Tilth is loose. Soil blowing is a very severe hazard.

The areas of these soils are used for crops, hay, and pasture. Native grasses include needle-and-thread, prairie sandreed, and threadleaf sedge. These soils are suited to cultivated crops if good management practices are used, but they are better suited to grasses.

Representative profile of Telfer loamy fine sand, in a cultivated field, 780 feet east and 675 feet south of northwest corner sec. 29, T. 131 N., R. 100 W.:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure parting to single grain; soft dry, loose moist, nonsticky wet; many fine roots; neutral; abrupt, smooth boundary.

A12—9 to 12 inches, dark grayish-brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak, fine, subangular blocky structure parting to single grain; soft dry, loose moist, nonsticky wet; many fine roots; neutral; gradual, wavy boundary.

C1—12 to 25 inches, light olive-brown (2.5Y 5/3) loamy fine sand, olive brown (2.5Y 4/3) moist; very weak, very coarse, prismatic structure parting to weak, coarse, subangular blocky structure; crushes to single grain; soft dry, loose moist, nonsticky wet; few roots; mildly alkaline; clear, wavy boundary.

C2—25 to 42 inches, light yellowish-brown (2.5Y 6/3) loamy fine sand, light olive brown (2.5Y 5/3) moist; single grain; soft dry, loose moist, nonsticky wet; very few roots; slight effervescence; mildly alkaline; gradual wavy boundary.

C3—42 to 54 inches, light-gray and light brownish-gray (2.5Y 6/2 and 7/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; single grain; few fine lime spots; slight effervescence; mildly alkaline; clear, wavy boundary.

C4—54 to 60 inches, pale-yellow and light-gray (2.5Y 7/2 and 7/4) stratified effervescent sandstone; crushes to loamy fine sand; hard and brittle dry, very soft moist; moderately alkaline.

Between depths of 10 and 40 inches is loamy sand, loamy fine sand, or sand. In places thin fine sandy loam strata and in the C horizon. In some places the profile is calcareous within a depth of 30 inches, and in others it is noncalcareous throughout. Depth to soft sandstone in most places is 40 to 60 inches, but it ranges from 40 inches to more than 60 inches. The A horizon is dark grayish-brown or grayish-brown loamy sand, loamy fine sand, sandy loam, or fine sandy loam. It is slightly acid or neutral and is 7 to 18 inches thick.

Telfer soils are associated with Flasher and Vebar soils. Telfer soils are deeper over sandstone than Flasher soils. They are coarser textured than Vebar soils.

Telfer loamy fine sand (Te).—This soil is on uplands. Most slopes are 3 to 6 percent, but slopes range from 0 to 6 percent. Most of the ridges are oriented with the prevailing northwest winds. In some places slopes are short and in others they are long. Blowouts are in a few places. Sandstone outcrops are in places. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Flasher and Vebar loamy fine sands.

Runoff is slow, and the soil absorbs most of the rainfall. This soil is very highly susceptible to soil blowing. Controlling soil blowing is a necessary part of good management.

Most areas of this soil are cultivated, but some areas remain in grasses. This soil is suited to cultivation if good management practices are used. Capability unit IVe–2; Sands range site; windbreak suitability group 7.

Telfer-Flasher loamy fine sands, sloping (TfC).—The soils in this complex are on uplands. Most slopes are 6 to 9 percent, but slopes range from 6 to 18 percent. The complex is 60 percent Telfer loamy fine sand, 20 percent Flasher loamy fine sand, 10 percent Vebar loamy fine sand and fine sandy loam, and 15 percent other soils. Some areas have blowouts. Sandstone outcrops are in places.

The profile of Telfer loamy fine sand is similar to the profile described as representative of the Telfer series, but the surface layer and subsoil are thinner.

The profile of Flasher loamy fine sand is similar to the profile described as representative of the Flasher series, but the surface layer is coarser textured.

Included with these soils in mapping are small areas of Vebar and Tally soils.

Runoff generally is slow, but in steep areas it is medium. The soil absorbs most of the precipitation. If these soils are cultivated or overgrazed, they are extremely susceptible to soil blowing. Available water capacity is low. Control of soil blowing is a necessary part of good management.

These soils are used mainly for grazing, and they are well suited to this use. They are not suited to cultivation. Management practices that maintain good grass cover, organic-matter content, and fertility are needed. Both soils in capability unit VIe–Sa; Telfer part in Sands range site; windbreak suitability group 7. Flasher part in Shallow range site; windbreak suitability group 10.

Toby Series

This series consists of deep, well-drained, nearly level to sloping soils on fans, terraces, and side slopes below higher areas. These soils formed in alluvium.

In a representative profile the surface layer is grayish-brown fine sandy loam about 8 inches thick. The subsoil is very friable fine sandy loam about 30 inches thick. The upper part is brown, and the lower part is light olive brown. The underlying material is grayish-brown fine sandy loam alluvium.

Permeability is moderately rapid. Available water capacity and organic-matter content are moderate. Fertility is medium. Tilth is good. Soil blowing is a severe hazard.

These soils are used for crops, hay, and pasture. Native grasses include needle-and-thread, prairie sandreed, western wheatgrass, and threadleaf sedge. These soils are suited to cultivated crops, trees, and grasses that are common in the county.

Representative profile of Toby fine sandy loam, nearly level, in a cultivated field, 40 feet east and 110 feet north of center of sec. 11, T. 130 N., R. 106 W.:

Ap—0 to 8 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium and fine, subangular blocky structure and weak, fine, crumb structure; slightly hard dry, very friable moist, slightly sticky and nonplastic wet; many roots and fine pores; neutral; abrupt, smooth boundary.

B21—8 to 22 inches, brown (10YR 5/3) fine sandy loam, brown grading to dark brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky structure; slightly hard dry, very friable moist, slightly sticky and nonplastic wet; common fine roots and pores; neutral; gradual, wavy boundary.

B22—22 to 38 inches, light olive-brown (2.5Y 5/3) fine sandy loam, olive brown (2.5Y 4/3) moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky structure; slightly hard dry, very friable moist, slightly sticky and nonplastic wet; common fine roots, common pores; mildly alkaline; gradual, wavy boundary.

C1—38 to 60 inches, grayish-brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, coarse, subangular blocky structure; slightly hard dry, very friable moist, slightly sticky and nonplastic wet; few fine roots, few pores; slight effervescence; moderately alkaline.

The solum ranges from 30 to 45 inches in thickness, which corresponds to the depth to carbonates. Depth to soft sedimentary beds in most places is more than 60 inches, but it ranges from 40 to 60 inches. In some places thin gravel lenses or a buried A horizon are at a depth below 40 inches. The A horizon is grayish-brown or light brownish-gray loam, sandy loam, and fine sandy loam. It is slightly acid or neutral and is 6 to 10 inches thick. The B horizon is brown, grayish-brown, or light olive-brown sandy loam or fine sandy loam. The structure of the B horizon is weak or moderate. The C horizon ranges from loamy fine sand to loam, but it generally is fine sandy loam.

Toby soils are associated with Kremlin soils. They are coarser textured than Kremlin soils.

Toby fine sandy loam, nearly level (ToA).—This soil is on terraces and fans. It has the profile described as representative of the series.

Included with this soil in mapping are 293 acres of Toby fine sandy loam, loamy substratum, and a few small areas of Rhame fine sandy loam.

Runoff is slow. This soil is highly susceptible to soil blowing. Controlling soil blowing is a necessary part of good management.

Most areas of this soil are cultivated, but some areas remain in grasses. The soil is suited to cultivation if good management practices are used. It is suited to irrigation. Capability unit IIIe–3; Sandy range site; windbreak suitability group 5.

Toby fine sandy loam, gently sloping (ToB).—This soil is on terraces and fans. Slopes are 3 to 6 percent. This soil has a profile similar to that described as representative of the series, but its solum is thinner.

Included with this soil in mapping are small areas of Manning fine sandy loam, Toby loam, and Parshall fine sandy loam.

Runoff is medium. This soil is highly susceptible to soil blowing. Controlling soil blowing is a necessary part of good management.

Most areas of this soil are cultivated, but some areas remain in grasses. This soil is suited to cultivated crops if good management practices are used. This soil is suited to irrigation. Capability unit IIIe–3; Sandy range site; windbreak suitability group 5.

Toby fine sandy loam, sloping (ToC).—This soil is on terraces and fans. Most slopes are 6 to 9 percent, but slopes range from 6 to 12 percent.

Included with this soil in mapping are small areas of Manning and Parshall fine sandy loams, and Zeona loamy fine sand.

Runoff is medium, and the hazard of water erosion is moderate. This soil is highly susceptible to soil blowing. Controlling soil blowing is a necessary part of good management.

Some areas of this soil are cultivated, and other areas remain in grasses. This soil is suited to cultivated crops if good management practices are used, but it is better suited to grass. Capability unit IVe–3; Sandy range site; windbreak suitability group 5.

Toby loam, nearly level (TrA).—This soil is on terraces. This soil has a profile similar to that described as representative of the series, but its surface layer is loam.

Included with this soil in mapping are small areas of Toby fine sandy loam.

Runoff is slow. This soil is moderately susceptible to soil blowing. Controlling soil blowing is a necessary part of good management.

This soil is used for crops, hay, and pasture. It is suited to cultivation if good management practices are used. It is suited to irrigation. Capability unit IIe–5; Sandy range site; windbreak suitability group 5.

Tusler Series

This series consists of moderately deep, excessively drained, sloping to steep soils on uplands. These soils formed in weathered sandstone.

In a representative profile the surface layer is grayish-brown loamy fine sand about 3 inches thick. Beneath the surface layer is loose, grayish-brown loamy fine sand about 7 inches thick. Below this is brown loamy fine sand, about 9 inches thick, that is underlain by light yellowish-brown loamy fine sand, about 8 inches thick, over soft sandstone.

Permeability is rapid. Available water capacity, organic-matter content, and fertility are low.

Most areas of Tusler soils are in native grasses, including prairie sandreed, needle-and-thread, and threadleaf sedge. Some sloping areas associated with Zeona and Rhame soils are cultivated. Tusler soils are not suited to cultivation.

Representative profile of a Tusler loamy fine sand in an area of Fleak-Tusler complex, steep, in native grass, 1,010 feet north and 820 feet west of center of sec. 30, T. 129 N., R. 106 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; very weak, fine, crumb structure; loose dry; many roots, matted; neutral; abrupt, smooth boundary.

C1—3 to 10 inches, grayish-brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; very weak, medium, subangular blocky structure; loose dry; many roots; slight effervescence; mildly alkaline; clear, wavy boundary.

C2—10 to 19 inches, brown (10YR 5/3) loamy fine sand, brown (10YR 4/3) moist; very weak, medium, subangular

blocky structure; loose dry; few roots; slight effervescence; mildly alkaline; gradual, wavy boundary.

C3—19 to 27 inches, light yellowish-brown (2.5Y 6/3) loamy fine sand, light olive brown (2.5Y 5/3) moist; very weak, medium, subangular blocky structure, some single grain; loose dry; few roots; strong effervescence; moderately alkaline; clear, wavy boundary.

C4—27 to 60 inches, light-gray (2.5Y 7/2) soft sandstone, grayish brown (2.5Y 5/2) moist; crushes to loamy fine sand; hard and brittle dry; strong effervescence; moderately alkaline.

Depth to sandstone typically is 20 to 30 inches, but it ranges from 20 to 40 inches. In some places the soil is noncalcareous. The A horizon is light brownish-gray or grayish-brown loamy fine sand, sandy loam, and fine sandy loam. It is slightly acid or neutral and is 2 to 6 inches thick. In places pockets and seams of carbonates are below the A horizon. The sandstone has hard and soft layers and a few ledges of very hard sandstone.

Tusler soils are associated with Fleak, Rhame, and Zeona soils. Tusler soils are deeper over sandstone than Fleak soils. They have a thinner solum than Rhame and Zeona soils.

Vebar Series

This series consists of moderately deep, well-drained, gently sloping to hilly soils on uplands. These soils formed in soft sandstone.

In a representative profile the surface layer is dark grayish-brown fine sandy loam about 6 inches thick. The subsoil is very friable, fine sandy loam about 16 inches thick. The upper part is grayish brown, and the middle and lower parts are brown. The underlying material is pale-brown fine sandy loam about 12 inches thick over sedimentary beds of sandstone.

Permeability is moderately rapid. Available water capacity is low to moderate. Organic-matter content is moderate. Fertility is medium. Tilth is good. Soil blowing is a severe hazard.

Vebar soils are used for crops, hay, and pasture. They are used mainly for crops. They are suited to cultivated crops, trees, and grasses that are common in the county. Native vegetation includes needle-and-thread, prairie sandreed, and threadleaf sedge.

Representative profile of Vebar fine sandy loam in an area of Vebar-Talley fine sandy loams, gently sloping, in a cultivated field, 150 feet east and 745 feet north of the southwest corner of sec. 27, T. 130 N., R. 99 W.:

Ap—0 to 6 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, medium and fine, crumb structure; soft dry, very friable moist, nonsticky and nonplastic wet; slightly acid; abrupt, smooth boundary.

B21—6 to 11 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, coarse, prismatic structure parting to weak coarse, subangular blocky structure; slightly hard dry, very friable moist, nonsticky and nonplastic wet; slightly acid; clear, wavy boundary.

B22—11 to 17 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky structure; slightly hard dry, very friable moist, nonsticky and nonplastic wet; neutral; gradual, wavy boundary.

B3—17 to 22 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to weak, coarse and medium, subangular blocky structure; slightly hard dry, very friable moist, nonsticky and nonplastic wet; strong effervescence; mildly alkaline; gradual, wavy boundary.

C1—22 to 34 inches, pale-brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, coarse and medium, subangular blocky structure; slightly hard dry, very friable moist, nonplastic and nonsticky wet; violent effervescence; moderately alkaline; clear, wavy boundary.

C2—34 to 60 inches, light brownish-gray (2.5Y 6/2) soft sandstone, weathered in the upper part; slightly hard dry, very friable moist, nonsticky and nonplastic wet; strong effervescence; moderately alkaline.

The solum ranges from 16 to 34 inches in thickness. Depth to carbonates generally is more than 15 inches, but it ranges from 10 to 24 inches. Depth to soft sandstone typically is 30 to 40 inches, but it ranges from 20 to 40 inches. The A horizon is dark grayish-brown or grayish-brown loam, sandy loam, fine sandy loam, or loamy fine sand. It is slightly acid or neutral and 4 to 9 inches thick. The B horizon is sandy loam or fine sandy loam and is brown, grayish brown, or light grayish brown. The structure of the B horizon is weak or moderate. The C horizon ranges from loamy fine sand to loam, but it generally is fine sandy loam.

Vebar soils are associated with the Desart, Flasher, Lefor, Tally, and Telfer soils. Vebar soils lack the claypan B horizon of Desart soils. They are deeper over sandstone than Flasher soils. They have a coarser textured B horizon than Lefor soils. They differ from the Tally soils in having bedrock at a depth of 20 to 40 inches. They contain less sand than Telfer soils.

Vebar-Flasher fine sandy loams, sloping (VfC).—The soils in this complex are on uplands. Slopes are 6 to 9 percent. The complex is 66 percent Vebar fine sandy loam, 16 percent Flasher fine sandy loam or loamy fine sand, 8 percent Telfer loamy fine sand, and 10 percent other included soils. Vebar soils have a thicker surface layer and subsoil and are deeper over sandstone than Flasher soils. Vebar soils are on the midslopes, and Flasher soils are on the crests of hills. Some of the soils are moderately eroded, and cultivation has exposed the lighter colored subsoil and substratum in some places.

The profile of Vebar fine sandy loam is similar to the profile described as representative of the Vebar series, but the surface layer and subsoil are thinner, and this soil is calcareous to the surface in places.

Flasher fine sandy loam has a profile similar to the one described as representative of the Flasher series, but in places the surface layer is loamy fine sand.

Included with the soils in this complex in mapping were small areas of Amor loam and Ekalaka fine sandy loam.

Runoff is medium. These soils are highly susceptible to soil blowing. Control of soil blowing is a necessary part of good management.

Many areas of these soils are cultivated, but some areas are in grasses. These soils are suited to cultivation if good management practices are used. Both soils in capability unit IVe–3; Vebar part in Sandy range site; windbreak suitability group 5. Flasher part in Shallow range site; windbreak suitability group 10.

Vebar-Flasher fine sandy loams, hilly (VfD).—The soils in this complex are on uplands. Slopes are mostly 9 to 12 percent but range from 9 to 15 percent. The complex is 55 percent Vebar fine sandy loam, 30 percent Flasher fine sandy loam and loamy fine sand, and 15 percent other soils. Vebar soils have a thicker solum than Flasher soils, and they are deeper over sandstone. Vebar soils are on the midslopes, and Flasher soils are on the crests of hills. Erosion has been moderate in places, and

cultivation has exposed the lighter colored subsoil and substratum in some places.

The profile of Vebar fine sandy loam is similar to the profile described as representative of the Vebar series, but the surface layer and subsoil are thinner.

Flasher fine sandy loam has a profile similar to the one described as representative of the Flasher series, but in places the surface layer is loamy fine sand.

Included with the soils in this complex in mapping were small areas of Amor loam.

Runoff is rapid. Water erosion is a moderate to severe hazard. Soil blowing and loss of organic matter are concerns if the soils are overgrazed or are cultivated. Proper grazing helps to maintain organic-matter content and soil fertility.

These soils are used for crops and grazing. The soils are better suited to grazing than to most other uses. Both soils in capability unit VIe–Sy; Vebar part in Sandy range site; windbreak suitability group 5. Flasher part in Shallow range site; windbreak suitability group 10.

Vebar-Tally fine sandy loams, gently sloping (VtB).—The soils in this complex are on uplands. Slopes are 3 to 6 percent. The complex is about 60 percent Vebar fine sandy loam, 25 percent Tally fine sandy loam, and 15 percent other soils. Vebar soils are shallower to soft sandstone than Tally soils. Vebar soils are on the higher parts of the landscape, and Tally soils are on the lower parts of slopes. Erosion has been moderate in places, and cultivation has exposed the lighter colored subsoil and substratum in some places.

Vebar fine sandy loam has the profile described as representative of the Vebar series.

Tally fine sandy loam has a profile similar to the one described as representative of the Tally series.

Included with these soils in mapping were small areas of Amor loam and Flasher fine sandy loam.

Runoff is medium. These soils are highly susceptible to soil blowing. Control of soil blowing is a necessary part of good management.

Most areas of these soils are cultivated, but some areas remain in grasses. The soils are suited to cultivation if good management practices are used. Both soils in capability unit IIIe–3; Sandy range site; windbreak suitability group 5.

Velva Series

This series consists of deep, well-drained, nearly level soils on bottom lands and terraces. These soils formed in alluvium.

In a representative profile the surface layer is grayish-brown fine sandy loam about 7 inches thick. Beneath the surface layer is very friable, grayish-brown fine sandy loam about 11 inches thick. This is underlain by grayish-brown, dark grayish-brown, light olive-brown, and pale-brown stratified loam to gravelly sandy loam.

Permeability, available water capacity, and organic-matter content are moderate. Fertility is medium. These soils are highly susceptible to soil blowing. Soil tilth is fair to good.

These soils are used for crops, hay, and pasture. They are suited to cultivated crops if good management practices are used. They are suited to irrigation. They are well suited to trees and grasses. The native vegetation consists mainly of prairie sandreed, needle-and-thread, and blue grama.

Representative profile of Velva fine sandy loam in a cultivated field, 740 feet west and 1,940 feet south of the northeast corner sec. 31, T. 129 N., R. 99 W.:

Ap—0 to 7 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure parting to weak, fine, crumb structure; slightly hard dry, very friable moist, slightly sticky and nonplastic wet; many roots; slight effervescence; mildly alkaline; abrupt, smooth boundary.

C1—7 to 18 inches, grayish-brown (2.5Y 5/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; weak, medium, angular blocky structure; slightly hard dry, very friable moist; many roots; slight effervescence; mildly alkaline; clear, smooth boundary.

C2—18 to 25 inches, grayish-brown (2.5Y 5.5/2) stratified sandy loam and fine sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, medium and fine, platy structure; slightly hard dry, very friable moist; common roots; common pores; slight effervescence; mildly alkaline; abrupt, smooth boundary.

A1b—25 to 29 inches, dark grayish-brown (10YR 4.5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, subangular blocky structure; hard dry; friable moist; slightly sticky and slightly plastic wet; common roots; many fine pores; slight effervescence; mildly alkaline; abrupt, smooth boundary.

C3—29 to 48 inches, light olive-brown (2.5Y 5/3) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; massive parting horizontally to very weak platy structure; slightly hard and soft dry; common roots; common pores; slight effervescence; mildly alkaline; clear, wavy boundary.

C4—48 to 60 inches, pale-brown (10YR 5.5/3) gravelly sandy loam, brown (10YR 4/3) moist; massive; soft dry, loose moist; few roots; slight effervescence; mildly alkaline.

Between depths of 10 and 40 inches, the material is mainly fine sandy loam, sandy loam, loam, and stratified loamy fine sand that average fine sandy loam. The strata range from 1 inch to several inches in thickness. In some places the stratified material is noncalcareous, and it is mottled in places. In some places the soil has gravel or gravel lenses. The A horizon is dark grayish-brown or grayish-brown loam, fine sandy loam, or sandy loam. It is mildly alkaline or moderately alkaline and is 4 to 8 inches thick.

Velva soils are associated with Korchea and Straw soils. Velva soils are coarser textured than Korchea or Straw soils.

Velva fine sandy loam (Vv).—This nearly level soil is on bottom lands and low terraces.

Included with this soil in mapping are small areas of Korchea loam and Riverwash. Also included are a few small areas of poorly drained soils in oxbows.

Runoff is slow. Runoff in spring and during seasonal storms sometimes floods these soils. The hazard of water erosion is slight. This soil is highly susceptible to soil blowing. Controlling soil blowing is a necessary part of good management.

This soil is used for hay, crops, and pasture. It is suited to cultivated crops if good management practices are used. Some areas are suited to irrigation. This soil is well suited to trees. Capability unit IIIe–3; Overflow range site; windbreak suitability group 1.

Wabek Series

This series consists of very shallow, excessively drained, gently sloping to steep soils on terraces and terrace edges. These soils formed in gravelly alluvium.

In a representative profile the surface layer is dark grayish-brown loam about 5 inches thick. Below this layer is dark grayish-brown gravelly loam about 3 inches thick. The underlying material is brown and pale-brown loamy gravel about 7 inches thick over pale-brown sand and gravel.

Permeability is very rapid. Available water capacity is very low. Organic-matter content is moderate. Fertility is low.

Most areas of these soils are in native grasses, including needle-and-thread, western wheatgrass, and blue grama. Wabek soils are not suited to cultivated crops. In places small areas associated with larger areas of Lehr, Manning, and Stady soils are cultivated.

Representative profile of a Wabek loam in an area of Wabek complex, in native grass, 462 feet west and 112 feet south of the northeast corner of NW¼ sec. 15, T. 131 N., R. 103 W.:

A11—0 to 5 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, coarse and medium, crumb structure; slightly hard dry, friable moist, slightly sticky and nonplastic wet; neutral; clear, smooth boundary.

A12—5 to 8 inches, dark grayish-brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; coarse and medium crumb structure; slightly hard dry, friable moist, slightly sticky and nonplastic wet; mildly alkaline; clear, smooth boundary.

IIC1ca—8 to 15 inches, brown and pale-brown (10YR 5/3 and 6/3) loamy gravel, dark brown (10YR 4/3 and 5/3) moist; single grain; loose dry, nonsticky and nonplastic wet; strong effervescence; gravel coated with lime; mildly alkaline; gradual, wavy boundary.

IIC2—15 to 60 inches, pale-brown (10YR 6/3) sand and gravel, brown (10YR 5/3) moist; stains on the gravel of yellowish brown (10YR 5/6) moist; single grain; loose dry, nonsticky and nonplastic wet; strong effervescence; gravel coated with lime; moderately alkaline.

The material above the sand or gravel ranges from 4 to 10 inches in thickness. The A horizon is grayish-brown or dark grayish-brown loam, gravelly loam, sandy loam, or fine sandy loam. A thin B horizon is in places. The C horizon is sand or gravelly sand in some places. In places the gravel in the C horizon is noncalcareous or only some strata are calcareous.

Wabek soils are associated with the Lehr, Manning, and Stady soils. They are shallower to gravel than the Lehr, Manning, and Stady soils.

Wabek complex (Wa).—The soils in this complex are on terraces, knolls, hills, and ridges of old terrace remnants and along the breaks or steep sides of gravelly terraces. Slopes range from 3 to 20 percent but are mainly more than 12 percent. This complex is 45 percent Wabek loam or fine sandy loam, 15 percent Cabba or Cabbart and Flasher or Fleak soils, 15 percent gravel, 15 percent Stady, Chanta, Lehr, and Manning soils, and 10 percent other soils. In some places Wabek soils are absent; and gravel caps the crests of ridges or hills, and the Cabba, Cabbart, Fleak, and Flasher soils are on the side slopes.

Included with these soils in mapping are small areas of Marmath and Reeder loams and Rhame and Vebar fine sandy loams.

Runoff is medium. Very shallow depth, very low available water capacity, and steepness are limitations. Controlled grazing helps to maintain good grass cover.

Most areas of these soils are in grasses. These soils are not suited to cultivation, but in places they are cultivated in small tracts along with other soils that are better suited to cultivation. Several areas are mined for gravel. Capability unit VIs–VS; Very Shallow range site; windbreak suitability group 10.

Watrous Series

This series consists of moderately deep, well-drained, nearly level and gently sloping soils on uplands. These soils have hard rock at a depth of 20 to 30 inches. They formed in material weathered from shale and sandstone.

In a representative profile the surface layer is grayish-brown loam about 4 inches thick. Below this is dark grayish-brown loam about 3 inches thick. The subsoil is friable brown clay loam about 15 inches thick. The underlying material is hard sandstone containing cracks and crevices. Some soil is in the crevices of the stone. Roots are unable to penetrate the stone, but some follow the crevices.

Permability and organic-matter content are moderate. Available water capacity is low. Fertility is medium. The soil material is not deep enough for deep-rooted crops. Tilth is good.

These soils are used for crops, hay, and pasture. Most areas are cultivated. They are suited to cultivated crops commonly grown in the county. Native vegetation includes green needlegrass, western wheatgrass, and blue grama.

Representative profile of Watrous loam, in native grass, 30 feet south and 100 feet west of northeast corner of SE¼ sec. 6, T. 130 N., R. 100 W.:

A11—0 to 4 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, medium, subangular blocky structure and moderate, fine, crumb structure; slightly hard dry, very friable moist, slightly sticky and slightly plastic wet; many roots and fine pores; slightly acid; clear, smooth boundary.

A12—4 to 7 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky structure; hard dry, friable moist, slightly sticky and slightly plastic wet; many roots and fine pores; slightly acid; clear, smooth boundary.

B21t—7 to 17 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky structure; very hard dry, friable moist, sticky and plastic wet; common roots; many fine pores; thin clay films; neutral; clear, wavy boundary.

B22t—17 to 22 inches, brown (10YR 5/3) clay loam, brown (10YR 4/3) moist; moderate, medium, prismatic structure parting to strong, medium, angular blocky structure; very hard dry, friable moist, sticky and plastic wet; common fine roots; common pores; few small stone fragments; mildly alkaline; abrupt, wavy boundary.

R—22 to 60 inches, hard gray sandstone; fractured in places.

The solum is commonly 20 to 32 inches thick, but it ranges from 20 to 40 inches. In some places carbonates are at a depth of 12 to 28 inches. Depth to hard rock in most places is 20 to 30 inches, but it ranges from 20 to 40 inches. The A horizon is grayish-brown or dark grayish-brown loam or silt loam. It is slightly acid or neutral and is 4 to 10 inches thick. The B2t horizon is grayish-brown and brown clay loam or silty clay loam. The structure of the B horizon is moderate or strong.

Watrous soils are associated with Morton and Reeder soils. They lack the soft sedimentary beds of Morton and Reeder soils.

Watrous loam (Wm).—This soil is on uplands. Slopes are 0 to 6 percent.

Included with this soil in mapping are small areas of Daglum, Reeder, and Shambo loams. Also included are a few small areas where rock is at a depth of less than 20 inches. Rock outcrops are in a few places.

Runoff is medium, and the hazard of water erosion is slight to moderate. The main needs of management are conserving moisture and maintaining fertility.

Most areas of this soil are cultivated, but some areas remain in grasses. The soil is suited to most crops commonly grown in the county. Capability unit IIIs–R; Silty range site; windbreak suitability group 6.

Wayden Series

This series consists of shallow, well-drained, gently sloping to very steep soils on uplands. These soils formed in shale.

In a representative profile the surface layer is light-gray silty clay about 3 inches thick. Below this is light-gray silty clay about 12 inches thick over pale-yellow soft beds of shale.

Permeability is slow. Available water capacity, organic-matter content, and fertility are low.

Most areas of these soils are in native grasses, and western wheatgrass, blue bunch wheatgrass, and blue grama are the primary species. Areas where slope is less than 9 percent are cultivated along with areas of associated Moreau and Regent soils. These soils in the Wayden series are better suited to grass than to other crops.

Representative profile of a Wayden silty clay in an area of Wayden-Moreau complex, sloping, in native grass, 475 feet north and 130 feet west of the southeast corner of sec. 13, T. 131 N., R. 102 W.:

A1—0 to 3 inches, light-gray (2.5Y 7/2) silty clay, grayish brown (2.5Y 5/2) moist; strong, very fine, granular structure; hard dry, friable moist, sticky and plastic wet; many fine and very fine roots; slight effervescence; moderately alkaline; clear, wavy boundary.

C1—3 to 7 inches, light-gray (5Y 7/2) silty clay, olive gray (5Y 5/2) moist; moderate, coarse and medium, subangular blocky structure parting to moderate, fine, subangular blocky structure; very hard dry, friable moist, sticky and plastic wet; common fine and very fine roots; common fine pores; strong effervescence; moderately alkaline; gradual, smooth boundary.

C2—7 to 15 inches, light-gray (5Y 7/2) silty clay, olive gray (5Y 5/2) moist; weak, coarse, subangular blocky structure parting to moderate, fine, subangular blocky structure; very hard dry, friable moist, sticky and plastic wet; common fine and very fine roots; many crystals of gypsum; few soft claystone chips; slight effervescence; moderately alkaline; gradual, wavy boundary.

C3—15 to 60 inches, pale-yellow (5Y 7/3) platy shale of silty clay texture, pale olive (5Y 6/) moist; yellowish-brown (10YR 5/6) moist stains on plates in places; extremely hard dry, very firm moist; slakes in water; slight effervescence; moderately alkaline.

Depth to shale ranges from 10 to 20 inches. The A horizon is light-gray, light brownish-gray, and grayish-brown clay loam, silty clay loam, and silty clay. It is mildly alkaline or moderately alkaline and is 2 to 6 inches thick. The A1 horizon is underlain by partly weathered shale in places. The sedimentary beds in the C horizon are soft shale. If crushed they are silty clay, silty clay loam, or clay. They have brown or reddish stains on platy shale layers and gypsum crystals or lenses in some places.

Wayden soils are associated with Cabba and Moreau soils. They are finer textured than Cabba soils. They have a thinner solum than Moreau soils.

Wayden-Moreau complex, sloping (WoC).—The soils in this complex are on uplands. Most slopes are 6 to 9 percent, but slopes range from 1 to 15 percent. The complex is 45 percent Wayden silty clay or silty clay loam, 30 percent Moreau silty clay or silty clay loam, 10 percent Cabba silty clay loam, 10 percent Rhoades and Absher soils, and 5 percent other soils. Wayden soils are in the convex higher positions, and Moreau soils are in the lower positions.

The Wayden soils have a profile similar to the one described as representative of the Wayden series, but in places the surface layer is silty clay loam.

The Moreau soils have a profile similar to that described as representative of the Moreau series, but it is thinner and in places the surface layer is silty clay loam.

Included with these soils in mapping were small areas of Chama and Morton silty clay loams.

Runoff is medium on these soils where slope is less than 9 percent and very rapid on steeper areas. Water erosion is a hazard if these soils are overgrazed or cultivated. Proper grazing is a necessary part of good management.

Most of the acreage of these soils is in grass. These soils are not suited to cultivation because of shallowness and steepness in places, but in places they are cultivated in small tracts along with other soils that are better suited to cultivation. Both soils in capability unit VIe–Sw; Wayden part in Shallow range site; windbreak suitability group 8; Moreau part in Clayey range site; windbreak suitability group 4.

Wolf Point Series

This series consists of deep, moderately well drained, level soils on bottom lands. These soils formed in alluvium.

In a representative profile the surface layer is grayish-brown silty clay loam about 1 inch thick. Below is very firm, grayish-brown clay about 9 inches thick. The underlying material is grayish-brown and olive-gray clay, about 19 inches thick, over olive-gray silty clay alluvium.

Permeability is slow. Available water capacity and organic-matter content are moderate. Fertility is medium. These soils are highly susceptible to soil blowing. They shrink and crack when dry.

These soils are used for hay, crops, and pasture. Native vegetation includes western wheatgrass, blue grama, and sagebrush. These soils are suited to cultivation if good management practices are used. They are suited to irrigation.

Representative profile of Wolf Point clay in native grass, 160 feet south and 825 feet east of the northwest corner of sec. 25, T. 132 N., R. 107 W.:

A11—0 to 1 inch, grayish-brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; platy structure; soft dry, friable moist, sticky and plastic wet; neutral; abrupt, smooth boundary.

A12—1 to 5 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak, medium and fine, angular blocky structure; extremely hard dry, very firm moist, very sticky and very plastic wet; neutral; gradual, wavy boundary.

A13—5 to 10 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; moderate, very fine, angular blocky structure; extremely hard dry, very firm moist, very sticky and very plastic wet; mildly alkaline; gradual, wavy boundary.

C1—10 to 18 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; massive; extremely hard dry, very firm moist, very sticky and very plastic wet; noneffervescent; few segregations of lime; mildly alkaline; diffuse, wavy boundary.

C2—18 to 29 inches, olive-gray (5Y 5/2) clay, olive gray (5Y 4/2) moist; weak, fine, blocky structure; extremely hard dry, very firm moist, very sticky and very plastic wet; noneffervescent; many segregations of gypsum coated with lime; mildly alkaline; diffuse, wavy boundary.

C3—29 to 60 inches, olive-gray (5Y 5/2) silty clay, olive (5Y 5/3) moist; massive; very hard dry, very sticky and very plastic wet; slight effervescence; common segregations of gypsum and lime; moderately alkaline.

Between depths of 10 and 36 inches the material is clay loam or clay that is 35 to 60 percent clay. In some places the material is stratified, and the strata range from 1 to 10 inches in thickness. A few places have a buried A horizon or thin lenses of coarse material. In some places the material is calcareous to the surface, and it is mottled. The A horizon is light-gray, grayish-brown, and light brownish-gray silty clay loam, silty clay, or clay. It is neutral or mildly alkaline and is 3 to 12 inches thick.

Wolf Point soils are associated with Havre and Korchea soils. They are finer textured than Havre and Korchea soils.

Wolf Point clay (Wp).—This soil is on bottom lands. It is mainly level, but it is undulating where old stream channels cross the benches.

Included with this soil in mapping are small areas of Korchea clay loam, wet variant; McKenzie clay; and Alluvial land, saline.

Runoff is slow. In places this soil is subject to flooding, because of runoff in spring and during seasonal storms. This soil is highly susceptible to soil blowing. Controlling soil blowing is a necessary part of good management. This soil is difficult to work.

This soil is used for crops, hay, and pasture. Most of it is used for hay. It is suited to most crops commonly grown in the county if good management practices are used. Very little corn is grown on this soil. Capability unit IIs–4; Clayey range site; windbreak suitability group 1.

Yawdim Series

This series consists of shallow, well-drained, sloping soils on uplands. These soils formed in shale.

In a representative profile the surface layer is grayish-brown silty clay about 3 inches thick. Below is light brownish-gray and light-gray silty clay, about 12 inches thick, over pale-yellow and light-gray sedimentary shale beds that are weathered in the upper part.

Permeability is slow. Available water capacity, organic-matter content, and fertility are low.

Most areas of these soils are in native grasses. Green needlegrass, western wheatgrass, and sandberry bluegrass are the main species. Where slope is less than 9 percent these soils are cultivated along with areas of associated deeper soils. Yawdim soils are better suited to grass than to most other crops.

Representative profile of Yawdim silty clay in an area of Yawdim silty clay, sloping, in native grass, 375 feet west and 910 feet south of the northeast corner of sec. 34, T. 130 N., R. 104 W.:

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak, fine, subangular blocky structure parting to moderate, fine, granular structure; very hard dry, friable moist, sticky and plastic wet; many roots; mildly alkaline; clear, smooth boundary.

C1—3 to 9 inches, light brownish-gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak, coarse, prismatic structure parting to moderate, medium and fine, subangular blocky structure; very hard dry, firm moist, sticky and plastic wet; common fine roots; common pores; few light olive-brown (2.5Y 5/4) moist mottles; slight effervescence; moderately alkaline; clear, wavy boundary.

C2—9 to 15 inches, light-gray (5Y 7/1) silty clay, gray (5Y 5/1) moist; weak, medium, angular blocky structure parting to weak, thin, platy structure; very hard dry, firm moist, sticky and plastic wet; few roots; few pores; few shale chips; strong effervescence; white spots of lime; moderately alkaline; clear, wavy boundary.

C3—15 to 20 inches, light-gray (5Y 7/2) partly weathered platy soft shale, crushes to silty clay, olive gray (5Y 5/2) moist; few roots in old pores and along plates; strong effervescence; many gypsum crystals and few spots of lime; moderately alkaline; gradual, wavy boundary.

C4—20 to 60 inches, pale-yellow and light-gray (5Y 7/3 and 7/1) platy shale, olive (5Y 5/3) moist; light yellowish-brown and black carbonaceous stains on plates in places; slight effervescence; moderately alkaline.

Depth to sedimentary beds ranges from 10 to 20 inches. The A horizon is grayish-brown or light grayish-brown clay loam, silty clay loam, or silty clay. It is mildly alkaline or moderately alkaline and is 2 to 6 inches thick. A transitional layer is between the A and C horizons in places. The A horizon is underlain by partly weathered shale in places. The sedimentary beds in the C horizon are soft shale. Gypsum crystals are numerous in places.

Yawdim soils are associated with Cabbart, Dilts, and Lisam soils. They are finer textured than Cabbart soils. They have less clay in the profile than the Dilts and Lisam soils, and their C horizon is less dense.

Yawdim silty clay, sloping (YaC).—This soil is on convex crests and the middle part of slopes.

Included in mapping are areas of Moreau silty clay loam and silty clay on lower plane and concave areas. Also included are small areas of Cabbart silty clay loam and Rhoades and Absher soils.

Runoff is medium where slope is less than 9 percent, and it is very rapid in the steeper areas. Water erosion is a concern if this unit is overgrazed or cultivated. Controlling grazing is a necessary part of good management.

Most areas of this soil are in grasses. In places it is cultivated in small tracts along with soils that are better suited to cultivation. This soil is not suited to cultivation, because of shallowness and, in places, steepness. Capability unit VIe–Sw; Shallow range site; windbreak suitability group 8.

Zeona Series

This series consists of deep, excessively drained, gently sloping, undulating, hummocky, and sloping soils on terraces and uplands. Some areas are on ridges, hummocks, dunes, and mounds. These soils formed in sand deposited by wind and water.

In a representative profile the surface layer is grayish-brown loamy fine sand about 6 inches thick. Below this is grayish-brown loamy fine sand about 18 inches thick. This is underlain by light brownish-gray and gray loamy fine sand, about 11 inches thick, over light-gray fine sand.

Permeability is rapid. Available water capacity is very low to low. Organic-matter content and fertility are low. Runoff is slow or none, except on frozen soil. These soils are porous and rapidly absorb water. They are extremely susceptible to soil blowing.

These soils are used for crops, hay, and pasture. Most of these soils are suited only to grass or wildlife because of their susceptibility to soil blowing. Native grasses include prairie sandreed, green needlegrass, sand bluestem, and some sedge.

Representative profile of Zeona loamy fine sand, gently sloping, in native grass, 100 feet east and 925 feet south of the northeast corner of sec. 25, T. 129 N., R. 106 W.:

A1—0 to 6 inches, grayish-brown (2.5Y 5/2) loamy fine sand, very dark grayish brown (2.5Y 3/2) moist; weak, fine, crumb structure parting to single grain; soft dry, loose moist, nonsticky and nonplastic wet; many roots; slightly acid; gradual, wavy boundary.

Ac—6 to 16 inches, grayish-brown (2.5Y 5/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; very weak, coarse, prismatic and very weak, coarse and medium, subangular blocky structure parting to single grain; soft dry, loose moist, nonsticky and nonplastic wet; many roots in upper part, common in lower part; slightly acid; clear, wavy boundary.

C1—16 to 24 inches, grayish-brown (2.5Y 5/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; very weak, coarse and medium, subangular blocky structure parting to single grain; loose dry, nonsticky and nonplastic wet; few roots; neutral; clear, wavy boundary.

C2—24 to 37 inches, light brownish-gray and light gray (2.5Y 6/2 and 7/2) loamy fine sand, olive gray (5Y 5/2) moist; very weak, coarse and medium, subangular blocky structure parting to single grain; loose dry, nonsticky and nonplastic wet; few fine roots; neutral; gradual boundary.

C3—37 to 60 inches, light-gray (5Y 7/2) fine sand, olive gray (5Y 5/2) moist; single grain; loose dry, nonsticky and nonplastic wet; few fine spots of lime; noneffervescent between spots; mildly alkaline.

Depth to carbonates is more than 36 inches in most places. Depth to sedimentary beds is more than 60 inches in most places. In some places the soil is single grain throughout. The A horizon is light-gray and grayish-brown or light brownish-gray fine sand or loamy fine sand. It is slightly acid or neutral and is 2 to 10 inches thick. The C horizon is fine sand, loamy fine sand, or sand.

Zeona soils are associated with Ekalaka, Fleak, Hanly, Rhame, and Tusler soils. They lack the claypan B horizon of Ekalaka soils. They are deeper over bedrock than Fleak and Tusler soils. They are less stratified and less subject to overflow from streams than Hanly soils. They are coarser textured than Rhame soils.

Zeona fine sand, hummocky (Zd).—This soil is on uplands and along the Little Missouri River. Slopes range from 2 to 12 percent. It is in stabilized areas. Slopes are short and irregular and have a maximum elevation difference of less than 25 feet. This soil has a profile similar to that described as representative of the series, but the surface layer and subsoil are fine sand. Some areas contain blowouts.

Included with this soil in mapping are areas of Zeona loamy fine sand. Also included in places are small areas of dunes and blowouts.

Runoff is slow except on frozen soil. This soil is porous and absorbs water rapidly. Internal drainage is rapid, but nearly all the water that is retained is available to plants. If this soil is overgrazed, it is extremely susceptible to soil blowing. Controlling grazing is a necessary part of good management.

All areas of this soil are used for grazing. This soil is suited only to use for grazing and as wildlife habitat. Capability unit VIe–TSa; Thin Sands range site; windbreak suitability group 10.

Zeona fine sand, undulating (ZeC).—This soil is on uplands. Slopes range from 0 to 12 percent. Slopes are short and have a maximum elevation difference of less than 15 feet. This soil has a profile similar to that described as representative of the series, but the surface layer and subsoil are fine sand.

Surface runoff is slow except on frozen soil. The soil is porous and absorbs water rapidly. Internal drainage is rapid, but nearly all of the retained water is available to plants. If this soil is overgrazed, it is extremely susceptible to soil blowing. Controlling grazing is a necessary part of good management.

All of this soil is used for grazing. This soil is suited only to grazing or wildlife. Capability unit VIe–TSa; Thin Sands range site; windbreak suitability group 10.

Zeona loamy fine sand, gently sloping (ZfB).—This soil is on terraces and uplands. Most slopes are 3 to 6 percent but range from 0 to 6 percent. This soil has the profile described as representative of the series. Most ridges are oriented with the prevailing northwest wind. Slopes are both short and long. Blowouts and sandstone outcrops are in a few places.

Included with this soil in mapping are small areas of Ekalaka and Fleak loamy fine sands, Rhame loamy fine sand and fine sandy loam. Tusler loamy fine sand, and some moderately eroded areas.

Surface runoff is slow. The soil absorbs most of the precipitation. Available water capacity is low. These soils are extremely susceptible to soil blowing. The main needs of management are controlling soil blowing and maintaining fertility. Proper grazing is a necessary part of good management.

This soil is used for pasture and crops. It is suited to cultivation if good management practices are used, but it is better suited to hay and pasture. Capability unit IVe–2; Thin Sands range site; windbreak suitability group 10.

Zeona-Tusler loamy fine sands, sloping (ZtC).—The soils in this complex are on terraces and uplands. Slopes range from 6 to 18 percent, but most are 6 to 9 percent. The complex is 60 percent Zeona loamy fine sand, 20 percent Fleak and Tusler loamy fine sands, 10 percent Rhame loamy fine sand and fine sandy loam, and about 10 percent other included soils. Most areas are sloping. Some places have blowouts and sandstone outcrops.

The profile of Zeona loamy fine sand is similar to that described as representative of the Zeona series, but the surface layer and subsoil are thinner, and some areas on terraces have a thicker surface layer.

The profile of Tusler loamy fine sand is similar to that described as representative of the Tusler series, but it is deeper over sandstone beds.

Surface runoff is slow. The soils absorb most precipitation. Available water capacity is low. Soil blowing is a serious hazard. If these soils are overgrazed, they are susceptible to soil blowing. The main need of management is maintaining fertility. Controlled grazing is a necessary part of good management.

These soils are well suited to grazing, and they are mainly used for that purpose. They are not suited to cultivation. Both soils in capability unit VIe–TSa; Thin Sands range site; windbreak suitability group 10.

Use and Management of the Soils

This section discusses the use and management of the soils in Bowman County for crops, range, wildlife habitat, and windbreaks. In addition, it describes the relative suitability of the soils for highway construction and other engineering work. A table showing predicted yields under two levels of management is also provided.

Crops [2]

About 45 percent of the acreage of Bowman County is cultivated. Spring wheat is the main crop. Oats, barley, and winter wheat are other important crops.

The soils in this county have many properties that affect their capabilities and limitations for cultivated crops. Among these properties are texture, structure, depth, permeability, air intake, slope, and chemical makeup. Climate and water also affect the use of soils. The usefulness of the soil is determined by the combination of properties. Texture affects other properties, such as structure, permeability, and water and air intake.

The steepness, length, and shape of slopes directly influence the loss of soil and water from an area. Climatic conditions, such as limited natural moisture supply, extremely low temperatures, and a short growing season affect the capabilities and limitations of the soils. Excess water in or on the soils is a limitation to use of the soils. Chemical makeup is important because plants obtain much of their food from the soil. If the soil does not have the nutrient elements needed by plants, they should be added. The presence of soluble salts or exchangeable sodium in amounts toxic to most plants is a limiting factor to the use of a soil for crops.

The main needs of management for use of the soils in Bowman County crops are conserving moisture, controlling soil blowing and water erosion, and maintaining fertility.

In dryfarmed areas moisture generally is conserved by reducing evaporation, limiting runoff, increasing infiltration, and controlling weeds. Among the effective practices are stubble mulching, contour farming, stripcropping, establishing field windbreaks, buffer strips, keeping tillage timely and to a minimum, using crop residue, and applying fertilizer. Periods of fallow help to control weeds and to increase the moisture content.

Among the measures that help to control soil blowing and water erosion are growing cover crops, stripcropping, planting buffer strips, establishing windbreaks, contour farming, constructing diversions and waterways, keeping tillage to a minimum, timely and emergency tillage, and using crop residue. A combination of several measures generally is used in this county.

Among the measures that help to maintain fertility are the application of fertilizer, green manure, and barnyard manure; the inclusion of cover crops, grasses, and legumes in the cropping system; and the use of summer fallow. Practices that help to control soil blowing and water erosion also help to maintain fertility.

To offset the effects of unfavorable soil characteristics, artificial drainage and reduction of salinity are needed in places.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible, but unlikely, major reclamation projects; and does not apply to horticultural crops or other crops requiring special management.

Those familiar with the capability classification (*6*) can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for trees, or for engineering.

In the capability system, the kinds of soils are grouped at three levels: the capability class, the subclass, and the unit, which are discussed in the following paragraphs.

Capability Classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use. (None in Bowman County.)

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife.

[2] By Edward R. Weimer, agronomist, Soil Conservation Service.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, water supply, or esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

For some soils, erosion or wetness and one of the other kinds of limitation are about equally important, and the subclass symbol shows both kinds. An example is IIIes.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about the management of soils. Capability units are designated by adding letters, an Arabic numeral, or both to the subclass symbol, for example, IIe–6 or IIIs–5. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass. Arabic numerals are also used to indicate susceptibility to soil blowing, ranging from 2, which is very high, to 7, which is slight. The letter P indicates the presence of a sodic claypan in the subsoil; the letter L indicates that the soil is limy; the letter M indicates that the soil has a medium-textured or moderately fine textured subsoil or substratum; and the letter R indicates that hard bedrock is at a moderate depth. Following the subclass designation in capability units in classes V, VI, and VII is an abbreviation of the name of the range site into which the soils of the unit have been placed.

Management by capability units

In the following pages, each of the capability units in Bowman County is described and suggestions for use and management are given. The units are not numbered consecutively, because not all of the units in the statewide system are represented in this county. The names of the soil series represented are mentioned in the description of each unit, but this does not mean that all the soils of a given series are in the unit. The capability designation for each soil in the county can be found in the "Guide to Mapping Units."

CAPABILITY UNIT IIe–4L

This unit consists of level and nearly level soils of the Havre series. These soils have lime at or near the surface. Organic-matter content is moderate. Fertility is medium. Available water capacity is moderate to high. Permeability is moderate.

These soils are used for crops, hay, and forage. They are suited to most crops commonly grown in the county. Wheat is the main crop. Barley, oats, flax, alfalfa, and corn are also grown. These soils are well suited to grasses.

These soils are subject to soil blowing. Conserving moisture; maintaining tilth, organic-matter content, and fertility; and controlling soil blowing are the main needs of management. Keeping crop residue on or near the surface helps to maintain water intake and to maintain or improve tilth.

CAPABILITY UNIT IIe–5

This unit consists of nearly level soils of the Shambo, Stady, and Toby series. These soils have a loam surface layer that has a clay content of less than 20 percent. Stady soils have gravel at a moderate depth. The soils in this unit have a friable subsoil and are easy to cultivate. They are moderately susceptible to soil blowing. Organic-matter content is moderate. Fertility is medium to high. Available water capacity is low to high. Permeability generally is moderate to moderately rapid, but it is very rapid in the gravel substratum of Stady soils.

These soils are suited to all crops commonly grown in the county. Wheat is the main crop. Barley, oats, flax, and corn are also grown. These soils are well suited to grasses.

Maintaining organic-matter content and fertility and controlling soil blowing are the main needs of management. The low available water capacity of Stady soils is the main limitation.

CAPABILITY UNIT IIe–6

This unit consists of gently sloping soils of the Amor, Arnegard, Chama, Grail, Morton, Reeder, and Shambo series. These soils have a surface layer of loam, silt loam, and silty clay loam that have a clay content of more than 20 percent but less than 35 percent. They have a friable subsoil and are easy to cultivate. Organic-matter content is moderate to high. Fertility is medium to high. Available water capacity is moderate to high. Permeability is moderate to moderately slow. The hazard of erosion is slight to moderate. During periods of heavy rains, there is a considerable amount of runoff. In a few places the soils are eroded.

These soils are suited to all crops commonly grown in the county. Wheat is the main crop. Barley, flax, oats, corn, and alfalfa are also grown. These soils are suited to grasses.

Conserving moisture, maintaining fertility and soil tilth, and controlling water erosion are the main needs of management. Constructing diversions and waterways and contour stripcropping are practices that help to control runoff and water erosion. Soil blowing is generally controlled if these soils are properly protected from water damage.

CAPABILITY UNIT IIe-7

This unit consists of gently sloping soils of the Grail and Regent series. These soils have a surface layer of silty clay loam that has a clay content of less than 35 percent and a subsoil of clay loam to silty clay. These soils are less susceptible to soil blowing than the other soils in the county. Organic-matter content is moderate to high. Fertility is high. Available water capacity is moderate to high. Permeability is moderately slow to slow. A considerable amount of water runs off these soils during heavy rains. In a few places the soils are eroded.

These soils are suited to all crops commonly grown in the county. Wheat is the main crop. Barley, oats, flax, alfalfa, and corn are also grown. These soils are suited to grasses.

Conserving moisture, maintaining organic-matter content and tilth, and controlling water erosion are the main needs of management. Diversions, waterways, and contour stripcropping help to control runoff and water erosion. Soil blowing is generally controlled if the soils are protected from water damage.

CAPABILITY UNIT IIs-4

This unit consists of nearly level soils of the Lawther and Wolf Point series. These soils have a surface layer of silty clay or clay that has a clay content of 40 percent or more. These soils form deep cracks in places when dry. Organic-matter content is moderate. Fertility is medium to high. Available water capacity is moderate to high. Permeability is slow. The soils are susceptible to soil blowing in spring after the clods are broken into granules that can be moved by wind.

These soils are suited to most crops commonly grown in the county. Wheat is the main crop. Barley, oats, and alfalfa are also grown. Some corn is grown on these soils, but they are not so well suited to corn as coarser textured soils. These soils are suited to grasses.

These soils are among the most difficult in the county to till because of the high content of clay. Conserving moisture, controlling soil blowing, and maintaining or improving tilth are the main needs of management.

CAPABILITY UNIT IIc-6

This unit consists of level and nearly level soils of the Amor, Arnegard, Chama, Cherry, Grail, Havre, Korchea, Kremlin, Morton, Reeder, Shambo, and Straw series. These soils have a surface layer of loam, silt loam, silty clay loam, and clay loam that has a clay content of more than 20 percent but less than 35 percent. They have a friable subsoil and are easy to cultivate. Organic-matter content is moderate to high. Fertility is medium to high. Available water capacity is moderate to high. Permeability is moderate to moderately slow.

These soils are well suited to all crops commonly grown in the county. Wheat is the main crop. Barley, flax, oats, corn, and alfalfa are also grown. These soils are well suited to grasses. Climate is the main limitation. Conserving moisture is the main concern of management.

CAPABILITY UNIT IIc-7

This unit consists of level and nearly level soils of the Grail, Regent, and Savage series. These soils have a surface layer of silty clay loam that has a clay content of less than 35 percent and a subsoil of clay loam to silty clay. They are less susceptible to soil blowing than the other soils in the county. Organic-matter content is moderate to high. Fertility is high. Available water capacity is moderate to high. Permeability is moderately slow to slow.

These soils are well suited to all crops commonly grown in the county. Wheat is the main crop. Barley, oats, flax, alfalfa, and corn are also grown. These soils are well suited to grasses.

Climate is the main limitation. Conserving moisture is the main need of management.

CAPABILITY UNIT IIIe-3

This unit consists of nearly level, gently sloping and undulating soils of the Glendive, Parshall, Rhame, Tally, Toby, Vebar, and Velva series. These soils have a surface layer of sandy loam or fine sandy loam. They are easy to cultivate. Permeability is moderate and moderately rapid. Available water capacity is low and moderate. Organic-matter content is moderate and high. Fertility is medium and high. These soils are highly susceptible to soil blowing.

These soils are suited to all crops commonly grown in the county. Wheat is the main crop. Barley, oats, flax, alfalfa, and corn are also grown. These soils are fairly well suited to corn. They are suited to grasses.

Controlling soil blowing, maintaining organic-matter content, fertility, and tilth, and conserving moisture are the main needs of management. Managing crop residue and using field windbreaks and stripcropping help to control soil blowing.

CAPABILITY UNIT IIIe-3M

This unit consists of gently sloping soils of the Lefor, Marmarth, Rhame, and Vebar series. These soils have a surface layer of fine sandy loam. These soils are mainly slightly eroded, but they are moderately eroded in places. Available water capacity is low to moderate. Permeability is moderate or moderately rapid on these soils. Organic-matter content is moderate. Fertility is medium. Soil blowing is the main hazard. These soils blow easily in unprotected areas. Water erosion is generally not a hazard, except when rains are heavy or when snow melts.

The soils are suited to all crops commonly grown in the county. Wheat is the main crop. Barley, oats, flax, alfalfa, and corn are also grown. These soils are suited to grasses.

Maintaining organic-matter content and fertility and controlling soil blowing are the main needs of management. These soils are easy to till.

CAPABILITY UNIT IIIe-3P

This unit consists only of Ekalaka-Desart fine sandy loams, gently undulating. These soils have a claypan in the subsoil that restricts the penetration of moisture and roots in most places. These soils absorb much of the moisture if the claypan is at a depth of more than 10 inches. Salts in the subsoil limit available moisture and plant nutrients for optimum plant growth. Permeability is moderately rapid to slow. Available water capacity is low to moderate, and organic-matter content is moderate.

Fertility is medium. These soils are highly susceptible to soil blowing. In places water erosion is a hazard during heavy rains and fast snow melts.

These soils are suited to most crops commonly grown in the county. Wheat is the main crop. These soils are suited to grasses.

Conserving moisture, maintaining organic-matter content and fertility, and controlling soil blowing are the main needs of management.

Growing cover crops and managing manure and crop residue are practices that help to maintain organic-matter content and fertility and to improve soil tilth. These practices, along with stripcropping, help to control soil blowing.

CAPABILITY UNIT IIIe–4L

This unit consists only of Patent loam, gently sloping. This soil has lime at or near the surface. Organic-matter content is moderately low. Fertility is medium. Available water capacity is moderate. Permeability is moderate. This soil is susceptible to soil blowing and water erosion.

This soil is used for crops, hay, and forage. It is suited to most crops commonly grown in the county. Wheat is the main crop. Barley, flax, oats, alfalfa, and corn are also grown. This soil is suited to grasses.

Conserving moisture, maintaining tilth, organic-matter content, and fertility and controlling water erosion and soil blowing are the main needs of management.

Growing cover crops and managing manure and crop residue are practices that help to maintain organic-matter content and to improve or maintain soil tilth. These practices, along with wind stripcropping and contour stripcropping, help to control soil blowing and water erosion.

CAPABILITY UNIT IIIe–6

This unit consists of gently sloping soils of the Amor, Cabba, Chama, Marmarth, Morton, and Reeder series and sloping soils of the Boxwell, Cherry, and Kremlin series. These soils have a surface layer of loam, silt loam, clay loam, or silty clay loam. Cabba soils have low fertility, organic-matter content, and available water capacity. The other soils have a friable subsoil, and they are easy to cultivate. Organic-matter content is moderate. Fertility is medium to high. Available water capacity is moderate to high. All the soils have moderate permeability. The hazard of soil blowing is slight, and the hazard of water erosion is moderate, especially if row crops are grown.

These soils are suited to most crops commonly grown in the county. Wheat is the main crop. Barley, flax, oats, and alfalfa are also grown. These soils are suited to grasses.

Conserving moisture, maintaining organic-matter content and fertility and controlling water erosion are the main needs of management.

Growing cover crops and managing manure and crop residue help to maintain organic-matter content and tilth. These practices, along with diversions, waterways, and contour stripcropping, help to control runoff and water erosion. If intensive management, including contour stripcropping, is used, more years of row crops can be grown in the rotation. Soil blowing is generally controlled if the soils are protected from water damage.

CAPABILITY UNIT IIIe–7

This unit consists of sloping soils of the Moreau and Regent series. The surface layer is silty clay loam that is less than 35 percent clay. These soils are among the soils in the county that are most resistant to soil blowing. Organic-matter content is moderate. Fertility is medium to high. Available water capacity is moderate to high. Permeability is slow. The hazard of water erosion is moderate to severe.

These soils are suited to most crops commonly grown in the county. Wheat is the main crop. Barley, oats, flax, and alfalfa are also grown. These soils are suited to grasses.

Maintaining tilth, organic-matter content, and fertility and controlling water erosion are the main needs of management.

Growing cover crops and managing manure and crop residue help to maintain organic-matter content and tilth. These practices, along with diversions, waterways, and contour stripcropping, help to control runoff and water erosion. Soil blowing is generally controlled if the soils are protected from water damage.

CAPABILITY UNIT IIIe–P

This unit consists of gently sloping soils of the Belfield, Grail, Marmarth, Moreau, Reeder, Regent, and Rhoades series. These soils have a surface layer of loam to silty clay loam. Rhoades soils have a claypan at a depth of less than 5 inches. In places the claypan is exposed at the surface. This soil has poor tilth. The claypan is slowly permeable to water, air, and plant roots, but once saturated it becomes very soft and is slow to dry. Where the claypan subsoil material has been mixed with the plow layer, the surface layer crusts as it dries. The other soils in this unit have fair to good tilth. Tillage and other farming operations are difficult where Rhoades soils are in a complex with other soils. The moisture content of the surface layer is not optimum at the same time for all of the soils in these complexes. Rhoades soils have very slow permeability and low available water capacity and fertility. They have moderate organic-matter content. The other soils in this unit have moderate to slow permeability. They have moderate to high available water capacity and organic-matter content and medium to high fertility.

These soils are used for hay, crops, and forage. They are suited to most crops commonly grown in the county. Wheat is the main crop. Because of the claypan soils, the rate of growth and height of crops are uneven.

Conserving moisture, maintaining organic-matter content and fertility, and controlling water erosion are the main needs of management.

Growing grasses and legumes and managing manure and crop residue help to maintain organic-matter content and to improve soil tilth. These practices, along with diversions, grass waterways, and contour stripcropping, help to control runoff and erosion. Soil blowing is generally controlled if these soils are protected from water damage.

CAPABILITY UNIT IIIes

This unit consists only of the nearly level and gently sloping soils of the Moreau series. These soils have a dense clay limiting layer. The surface layer is granular. Per-

meability is slow. Available water capacity and organic-matter content are moderate. Fertility is medium. These soils are difficult to work. They are susceptible to soil blowing because of the granular surface layer. Water erosion is a hazard when rains are heavy or when snow melts.

These soils are suited to most crops commonly grown in the county. Wheat is the main crop. Corn is not so well suited to these soils as it is to some of the coarser textured ones. These soils are suited to grasses.

Conserving moisture, maintaining organic-matter content and fertility, and controlling soil blowing and water erosion are the main needs of management.

Growing cover crops and managing manure and crop residue help to maintain organic-matter content and to improve soil tilth. These practices, along with diversions, waterways, and stripcropping, help to control soil blowing.

CAPABILITY UNIT IIIes–3

This unit consists of nearly level and gentlv sloping soils of the Manning series. These soils have gravel or sand layers at a depth of 20 to 40 inches. They have a surface layer mainly of fine sandy loam or loam. They absorb water readily. Permeability is moderately rapid over rapid and very rapid. Available water capacity is low because of the gravel or sand stratum. Organic-matter content is moderate. Fertility is medium.

These soils are used for crops, hay, and forage. They are suited to all crops commonly grown in the county. Wheat is the main crop.

Conserving moisture, maintaining organic-matter content and fertility, and controlling soil blowing are the main needs of management.

Growing cover crops and managing manure and crop residue help to maintain organic-matter content and soil tilth. These practices, along with wind stripcropping and field windbreaks, help to control soil blowing.

CAPABILITY UNIT IIIes–5

This unit consists of gently sloping and sloping soils of the Chanta, Lehr, Searing, and Stady series. These soils have a gravel or porcellanite layer at a depth of 20 to 40 inches. They have a surface layer of loam. The soils are easy to cultivate. Available water capacity is low to moderate. Chanta and Stady soils have moderate over very rapid permeability. Searing soils have moderate permeability. Lehr soils have moderately rapid permeability above the substratum and very rapid below. Organic-matter content is moderate. Fertility is medium.

These soils are used for crops, hay, and forage. They are suited to most crops commonly grown in the county. Wheat is the main crop. Barley, flax, oats, alfalfa, and corn are also grown.

The limited available water capacity affects crops mainly in years when rainfall is below normal. Conserving moisture, maintaining organic-matter content and fertility, and controlling soil blowing and water erosion are the main needs of management.

Managing crop residue on the surface and stripcropping are practices that help to control soil blowing.

CAPABILITY UNIT IIIs–5

This unit consists of nearly level soils of the Chanta and Stady series. These soils have a surface layer of loam. They have a gravel or porcellanite layer at a depth of 20 to 40 inches. These soils are easy to cultivate. Available water capacity is low. Permeability is moderate over very rapid. Organic-matter content is moderate. Fertility is medium. Soil blowing is a hazard if these soils are cultivated.

These soils are used for crops, hay, and forage. They are suited to most crops commonly grown in the county. Wheat is the main crop.

Conserving moisture, maintaining organic-matter content and fertility, and controlling soil blowing are the main needs of management. The low available water capacity limits the use of these soils for cultivated crops.

Managing crop residue on the surface and stripcropping are practices that help to control soil blowing.

CAPABILITY UNIT IIIs–P

This unit consists of nearly level soils of the Belfield, Grail, Kremlin, Lawther, Marmarth, Reeder, Regent, Rhoades, Savage, and Shambo series. These soils have a surface layer of loam to silty clay loam. Rhoades soils have a claypan at a depth of less than 5 inches. In places the claypan is exposed at the surface. Rhoades soils have poor tilth. The claypan is slowly permeable to water, air, and plant roots, but once saturated it becomes very soft and is slow to dry out. Where the claypan subsoil has been mixed in the plow layer, the surface crusts as it dries. The other soils in this unit have fair to good tilth. Tillage and other farming operations are difficult where Rhoades soils are in a complex with other soils. The moisture content of the surface layer is not optimum at the same time for all of the soils. Rhoades soils have very slow permeability and low available water capacity and fertility. They have moderate organic-matter content. The other soils in this unit have moderate to slow permeability. They have moderate to high available water capacity and organic-matter content and medium to high fertility.

These soils are used for hay, crops, and forage. They are suited to most crops commonly grown in the county. Wheat is the main crop. Because of the claypan soils, the rate of growth and height of crops are uneven.

Conserving moisture and maintaining organic-matter content and fertility are the main needs of management. Growing grasses and legumes and using manure and crop residue are practices that help to maintain organic-matter content and to improve tilth.

CAPABILITY UNIT IIIs–R

This unit consists only of nearly level to gently sloping Watrous loam. This soil has a limiting layer of bedrock. In places the bedrock is exposed at the surface. Fertility is medium. Organic-matter content is moderate. Available water capacity is low. Permeability is moderate. This soil is easy to cultivate.

The soil is well suited to all crops commonly grown in the county. Wheat is the main crop. Barley, oats, flax, alfalfa, and corn are also grown. This soil is well suited to grasses.

Conserving moisture and maintaining organic-matter content and fertility are the main needs of management.

CAPABILITY UNIT IIIws–4

This unit consists of nearly level soils of the Grail and Regan series. Regan soils are poorly drained, and Grail soils are moderately well drained or poorly drained. The soils have a surface layer of loam, silt loam, clay loam, and silty clay loam. In places salts are exposed on the surface. Some of the soils have a high lime content. Organic-matter content is high, and fertility is medium. Available water capacity is moderate. Permeability is moderate. Tilth is poor. A seasonal water table that recharges the soils with salts is present. The saline condition, wetness, and soil blowing are the main limitations to use of these soils. These soils blow easily when the surface is dry and granulated. These soils are too wet in spring for early tillage, even in the moderately well drained areas.

These soils are suited to grasses and forage. Only late-seeded crops can be grown in most years. Newly seeded crops show the effects of salt by having spotty germination and emergence. Barley and other salt-tolerant crops are suitable if these soils are cultivated.

Maintaining organic-matter content and fertility, improving drainage and tilth, and controlling soil blowing are the main needs of management. Some of the wetter areas need artificial drainage before crops can be grown. Drainage is not feasible in many areas.

CAPABILITY UNIT IVe–2

This unit consists of soils of the Telfer and Zeona series. These soils have a surface layer of loamy fine sand. They are slightly to moderately eroded. They are easy to cultivate but are extremely susceptible to soil blowing. They absorb most of the rainfall, but available water capacity is very low and low. Permeability is rapid. Organic-matter content is moderate and low, and fertility is low.

These soils are suited to most crops commonly grown in the county, but they are subject to soil blowing unless a plant cover or plant residue is kept on the surface. Wheat is the main crop. These soils are better suited to grasses than to most other uses.

Conserving moisture, maintaining organic-matter content and fertility and controlling soil blowing are the main needs of management. Growing cover crops and managing manure and crop residue help to maintain organic-matter content, fertility, and tilth. These practices, along with stripcropping, help to control soil blowing.

CAPABILITY UNIT IVe–2P

This unit consists only of Ekalaka-Zeona-Ladner loamy fine sands, gently sloping. These soils are slightly to moderately eroded. Ekalaka and Ladner soils have a claypan in the subsoil. All of these soils are easy to cultivate, but they are extremely susceptible to soil blowing. They absorb most of the rainfall where the claypan subsoil is at a depth of more than 15 inches. Available water capacity is low to moderate. Permeability is moderately rapid above the claypan subsoil in Ekalaka soils and it is slow in the subsoil. Permeability is slow in Ladner soils and rapid in Zeona soils. Organic-matter content is low and moderate in the soils of this unit. Fertility is low and medium.

These soils are suited to most crops commonly grown in the county, but they are subject to soil loss and loss of organic matter by soil blowing unless a cover of plants or plant residue is kept on the surface. Wheat is the main crop. These soils are better suited to grasses than to most other uses.

Conserving moisture, maintaining organic-matter content and fertility, and controlling soil blowing are the main needs of management. Growing cover crops and managing manure and crop residue help to maintain organic-matter content, fertility, and tilth. These practices, along with wind stripcropping, help to control soil blowing.

CAPABILITY UNIT IVe–3

This unit consists of sloping soils of the Flasher, Fleak, Lefor, Marmarth, Rhame, Tally, Toby and Vebar series. Most of the soils have a surface layer of fine sandy loam. They are easy to cultivate. The Flasher and Fleak soils have moderately rapid and rapid permeability. They have very low available water capacity and low organic-matter content and fertility. The other soils in this unit have medium fertility and moderate organic-matter content. Available water capacity is low to moderate. Permeability is moderate and moderately rapid. These soils are highly susceptible to soil blowing.

These soils are suited to most crops commonly grown in the county. Wheat is the main crop. Barley, oats, flax, alfalfa, and corn are also grown. These soils are suited to grasses.

Controlling soil blowing, maintaining organic-matter content, fertility, and tilth, and conserving moisture are the main needs of management. Leaving crop residue on the surface and using field windbreaks and stripcropping are practices that help to control soil blowing.

CAPABILITY UNIT IVe–3P

This unit consists of the gently sloping soils of the Daglum series and the rolling soils of the Ekalaka and Ladner series. These soils have a surface layer of fine sandy loam, sandy loam, and loamy fine sand, but mainly of fine sandy loam. Most of the soils are easy to cultivate, but they are highly susceptible to soil blowing. Permeability is slow to moderately rapid in the upper part and slow in the lower part. Available water capacity is low to moderate. Organic-matter content is low to moderate. Fertility is low to medium. Water erosion is a hazard on the Daglum soils.

These soils are suited to most crops commonly grown in the county. Wheat is the main crop. These soils are better suited to grasses than to most other uses. They are subject to loss of soil and organic matter because of water erosion and soil blowing.

Conserving moisture, maintaining organic-matter content and fertility, controlling soil blowing, and, in places, controlling water erosion are the main needs of management. Growing grasses and managing manure and crop residue help to maintain organic-matter content and fertility and to improve tilth. These practices, along with wind stripcropping, help to control soil blowing.

CAPABILITY UNIT IVe-4L

This unit consists of sloping soils of the Amor, Boxwell, Cabba, and Cabbart series. The soils in this unit have a surface layer of loam or silt loam. Available water capacity, organic-matter content, and fertility are low in Cabba and Cabbart soils. Available water capacity and organic-matter content are moderate in Amor and Boxwell soils, and fertility is medium. Permeability is moderate in all the soils in this unit. The hazard of water erosion is severe, and the hazard of soil blowing is moderate.

These soils are better suited to grasses than to most other plants. Wheat is the main crop. Tilling up and down hill accelerates runoff and water erosion.

Controlling water erosion, conserving moisture, and maintaining organic-matter content, tilth, and fertility are the main needs of management. Growing grasses and legumes and managing manure and crop residue help to maintain organic-matter content and fertility and to improve tilth. These practices, along with diversion ditches, grassed waterways, and contour stripcropping, are needed if these soils are used for crops most of the time. Perennial grasses are needed in the crop rotation at least half the time.

CAPABILITY UNIT IVe-6

This unit consists of sloping and strongly sloping soils of the Amor, Boxwell, Cabba, Cabbart, and Marmarth series. These soils have a surface layer of loam or silt loam. Permeability is moderate in the soils of this unit. All of the soils except the Cabba and Cabbart soils have moderate available water capacity and organic-matter content and medium fertility. Cabba and Cabbart soils have low available water capacity, organic-matter content, and fertility. Water erosion is a severe hazard on the soils of this unit.

These soils are suited to most crops commonly grown in the county, but intensive management is needed. Wheat is the main crop. These soils are suited to grasses.

Conserving moisture; maintaining organic-matter content, soil tilth, and fertility; and controlling water erosion are the main needs of management. Growing cover crops and managing manure and crop residue help to maintain organic-matter content, fertility, and soil tilth. These practices, along with diversions, waterways, and contour stripcropping, help to control runoff and water erosion and are needed on the soils that are cropped most of the time. Tilling up and down the slope reduces runoff and helps to control water erosion. Perennial grasses are needed in the crop rotation to help to control water erosion.

CAPABILITY UNIT IVe-P

This unit consists of sloping soils of the Marmarth, Reeder, and Rhoades series. These soils have a layer of loam to silty clay loam. Rhoades soils have a claypan at a depth of less than 5 inches. In places the claypan is exposed at the surface. Rhoades soils have poor tilth. The claypan is slowly permeable to water, air, and plant roots, but once saturated it becomes very soft and is slow to dry. Where the claypan subsoil has been mixed with the plow layer, the surface crusts as it dries. The other soils have fair to good tilth. Tillage and other farming operations are difficult on the soils in this unit because the moisture content is not optimum at the same time for all of the soils. Rhoades soils have very slow permeability and low available water capacity. Organic-matter content is moderate. Fertility is low. The Marmarth and Reeder soils have moderate available water capacity and organic-matter content and have medium fertility.

The soils in this unit are suited to most crops commonly grown in the county, but intensive management is needed. Wheat is the main crop. Barley, flax, oats, and alfalfa are also grown. These soils are better suited to grasses than to most other uses.

Conserving moisture, maintaining organic-matter content and fertility, and controlling water erosion are the main needs of management. Growing grasses and legumes and managing manure and crop residue help to maintain organic-matter content and fertility and to improve soil tilth. These practices, along with diversions, waterways, and contour stripcropping, help to control runoff and water erosion. Using intensive management practices, including diversions and contour stripcropping, more years of cropping and fewer years of grass can be safely used in rotations.

CAPABILITY UNIT IVes-3

This unit consists of sloping soils of the Lehr, Manning, and Wabek series. These soils have gravel or sand at a depth of 10 to 40 inches. They have a surface layer mainly of loam or fine sandy loam. Wabek soils have very rapid permeability and very low available water capacity. They have low fertility and moderate organic-matter content. Permeability is moderately rapid above the gravel substratum in Lehr and Manning soils, and it is very rapid below. Available water capacity is low in these soils, and they have medium fertility and moderate organic-matter content. Soil blowing is a hazard if these soils are cultivated.

These soils are used for crops, hay, and grazing. They are suited to cultivation if good management practices are used, but they are better suited to grasses.

The limited available water capacity is the main limitation. Conserving moisture, maintaining organic-matter content and fertility, and controlling soil blowing are the main needs of management. Growing cover crops and managing manure and crop residue help to maintain organic-matter content, fertility, and tilth. These practices, along with stripcropping, help to control soil blowing.

CAPABILITY UNIT IVes-4

This unit consists only of Moreau-Wayden silty clays, sloping. The surface layer has a clay content of 35 percent or more. These soils take in water slowly. They are difficult to work. Moreau soils have slow permeability, moderate available water capacity and organic-matter content, and medium fertility. Wayden soils have slow permeability and low available water capacity, organic-matter content, and fertility. If the soils of this unit are tilled, soil blowing and water erosion are the main hazards because of the granular surface layer and steepness of slope.

These soils are suited to most crops commonly grown in the county, but intensive management is needed. Wheat is the main crop. Corn is not so well suited to these soils as

to coarser textured ones. These soils are better suited to grasses than to other uses.

Conserving moisture and controlling soil blowing and water erosion are the main needs of management. Tilling up and down the slope helps to control water erosion and to reduce runoff. Growing cover crops and managing manure and crop residue help to maintain organic-matter content and to improve tilth. These practices, along with diversions, waterways, and wind stripcropping, help to control runoff, water erosion, and soil blowing.

CAPABILITY UNIT IVs–P

This unit consists of the nearly level soils of the Daglum and Rhoades series. The surface layer ranges from loam to silty clay loam, but it is mainly loam. Rhoades soils have a claypan at a depth of less than 5 inches. In places the claypan is exposed at the surface. The Rhoades soils have poor tilth. The claypan is slowly permeable to water, air, and plant roots, but once saturated it becomes very soft and is slow to dry. Where the claypan subsoil has been mixed with the material in the plow layer, the surface crusts as it dries. Daglum soils have fair tilth. Tillage and other farming operations are difficult on these soils because the moisture content is not optimum at the same time for all of the soils. Rhoades soils have very slow permeability, low available water capacity, moderate organic-matter content, and low fertility. Daglum soils have slow permeability, moderate available water capacity and organic-matter content, and medium fertility.

The soils in this unit are suited to most crops commonly grown in the county, but intensive management is needed. Wheat is the main crop. Barley, flax, oats, and alfalfa are also grown. These soils are suited to grasses.

Conserving moisture and maintaining organic-matter content and fertility are the main needs of management. Growing grasses and legumes and managing manure and crop residue are practices that help to maintain organic-matter content and fertility and to improve tilth.

CAPABILITY UNIT IVsw

This unit consists only of the Heil part of the nearly level McKenzie and Heil silty clays. This is a poorly drained, shallow soil in depressions or basins. It is ponded during rainy periods and spring runoff. Most areas are more than 40 percent clay to a depth of more than 30 inches. The surface layer is mainly silty clay but is silty clay loam or silty clay in places. The subsoil is dense clay. Some moderately deep and deep areas are in places. Fertility is medium, and organic-matter content is moderate. Available water capacity is moderate, and permeability is very slow. Soil blowing is a hazard if the surface is dry, bare, and granulated.

Most of this soil is used for wheat, but some oats, barley, and alfalfa are grown. This soil is not suited to corn. It is better suited to grasses than to other uses.

Maintaining organic-matter content and fertility, improving drainage and controlling soil blowing are the main needs of management. Adequate drainage is necessary before timely cultivation and seeding is practical. On some of the wetter areas, some artificial drainage is needed before crops can be grown. This soil is difficult to work. Good tilth is difficult to maintain. Tillage must be done at the proper moisture content. Wetness delays planting in spring. Sometimes newly seeded crops that are affected by salts have spotty germination and emergence. In places salts in the subsoil and in the substratum limit yields.

CAPABILITY UNIT Vw–WL

Only the nearly level Alluvial land, wet, is in this unit. It is in drainageways and below springs and seeps. A water table keeps the areas wet most of the time.

It is not practical to drain Alluvial land, wet. This land type is suited only to grazing and wildlife.

CAPABILITY UNIT VIe–Ov

This unit consists of nearly level soils of the Hanly, Havre, Korchea, and Straw series. These soils have a surface layer of loam, silt loam, fine sandy loam, and loamy fine sand. They are on flood plains of streams that are cut up by stream channels. Permeability is moderate and rapid. The Havre, Korchea, and Straw soils have high available water capacity, moderate and high organic-matter content, and medium and high fertility. The Hanly soils have low available water capacity, moderate organic-matter content, and low fertility. These soils are subject to water erosion and soil deposition from runoff during heavy rains. The Hanly soils are extremely susceptible to soil blowing if they are overgrazed or tilled.

These soils are not suited to cultivation, because they are cut up by stream channels. They are better suited to grazing than to other uses.

Controlling erosion is the main concern of management. Grazing needs to be controlled to maintain enough vegetation to protect the soils from water erosion and soil blowing.

CAPABILITY UNIT VIe–Sa

This unit consists only of Telfer-Flasher loamy fine sands, sloping. These are excessively drained soils on uplands. They have a surface layer of loamy fine sand. They absorb most of the rainfall, but available water capacity is low and very low. Fertility and organic-matter content are low. If overgrazed or tilled, these soils are extremely susceptible to soil blowing.

These soils are not suited to cultivation, because of the limited available water capacity and susceptibility to soil blowing. They are suited to grazing. Some areas are used for hay. Some areas are suited to wildlife.

Controlling soil blowing is the main concern of management. Grazing needs to be controlled to maintain enough vegetation to protect the soil from soil blowing.

CAPABILITY UNIT VIe–Si

This unit consists of sloping and strongly sloping soils of the Boxwell, Cabbart, and Patent series. These soils have a surface layer of loam. Available water capacity is low and moderate. Permeability is moderate. Organic-matter content is low to moderate. Fertility is low and medium. Water erosion is a hazard if these soils are overgrazed or tilled.

These soils are not suited to cultivation. Areas now cultivated need to be seeded to grass. The soils are suited to grazing. Some areas are used for hay. Some areas are suited to wildlife.

Controlling erosion is the main need of management. Grazing needs to be controlled to maintain enough vegetation to protect the soils from water erosion.

CAPABILITY UNIT VIe-Sw

This unit consists of sloping, hilly, and steep soils of the Amor, Boxwell, Cabba, Cabbart, Flasher, Fleak, Moreau, Rhame, Tusler, Wayden, Yawdim, and Vebar series. The soils range from sandy to clayey. Fertility ranges from low to medium. Organic-matter content is low or moderate. Available water capacity ranges from very low to moderate. Permeability ranges from rapid to slow. If some of these soils are overgrazed or tilled, the hazard of water erosion is severe. Others are extremely susceptible to soil blowing.

The soils in this unit are too thin or too steep for cultivation. They are well suited to grazing. Some areas are used for hay and some are suited to wildlife.

Controlling water erosion and soil blowing are the main needs of management. Grazing needs to be controlled to maintain enough vegetation to protect the soils from water erosion and soil blowing. In addition, management practices that improve range and pasture are needed.

CAPABILITY UNIT VIe-Sy

This unit consists of hilly soils of the Flasher, Fleak, Rhame, and Vebar series. The soils in this unit have a surface layer of fine sandy loam. All the soils have rapid or moderately rapid permeability. Flasher and Fleak soils have very low available water capacity and low fertility and organic-matter content. Rhame and Vebar soils have low to moderate available water capacity, medium fertility, and moderate organic-matter content. The soils in this unit are highly susceptible to soil blowing if they are overgrazed or cultivated.

These soils are not suited to cultivation. Areas now cultivated need to be seeded to grass. The soils are suited to grazing. Some areas are used for hay. Some are suited to wildlife.

Controlling soil blowing is the main need of management. Grazing needs to be controlled to maintain enough vegetation to protect the soils from erosion.

CAPABILITY UNIT VIe-TSa

This unit consists of nearly level to sloping and undulating to hummocky soils of the Hanly, Tusler, and Zeona series and of areas of Blown-out land. The soils have a surface layer of loamy fine sand and fine sand. Permeability is rapid. Available water capacity is low and very low. Organic-matter content is low in the Tusler and Zeona soils and moderate in the Hanly soils. Fertility is low. These soils are extremely susceptible to soil blowing if they are overgrazed or tilled.

These soils are not suited to cultivation, because of limited available water capacity and susceptibility to soil blowing. They are suited to grazing. Some areas are suited to wildlife.

Controlling soil blowing is the main need of management. Grazing needs to be controlled to maintain enough vegetation to protect the soil from soil blowing.

CAPABILITY UNIT VIw-Ov

This unit consists only of nearly level Korchea clay loam, wet variant. This alluvial soil is deep and poorly drained. It is in oxbows and in the bottoms of old channels on the flood plains along streams.

This soil is too poorly drained for cultivation. Some areas have dense stands of grass and sedges around the edges, and the lower parts are almost void of vegetation or have cattails and other aquatic plants. Others have dense stands of grass and sedges throughout. These areas are used for pasture or hay.

Protecting the areas from flooding and ponding is the main concern of management.

CAPABILITY UNIT VIs-CD

This unit consists of nearly level, poorly drained soils of the McKenzie series. The soils are in flat-bottomed depressions or basins. The surface layer is silty clay. Permeability is very slow. Available water capacity and organic-matter content are moderate. Fertility is medium.

These soils are used mainly for grazing, but a few areas are used for hay. These soils are not suited to cultivation. Some areas provide sites for dugout ponds. Some areas are suited to wildlife.

Controlled grazing is a necessary management practice.

CAPABILITY UNIT VIs-SS

This unit consists of areas of Alluvial land, saline, and of Alluvial land, strongly saline. These soils have a surface layer of loam, clay loam, silty clay, or clay. They contain salt accumulations on the surface. Barren, dispersed areas are common. Most of these areas have a seasonal high water table.

These areas are not suited to cultivation, because they are saline and strongly saline. They are suitable for native grasses for range or hay. They are also suited to wildlife.

Controlled grazing is a necessary management practice.

CAPABILITY UNIT VIs-SwC

This unit consists only of Dilts and Lisam clays, rolling. Shale outcrops are in places. The native vegetation in places includes some Rocky Mountain juniper and a few pine. Permeability is slow. Available water capacity, fertility, and organic-matter content are low. Reaction ranges from extremely acid to moderately alkaline in these soils. Water erosion is the main hazard.

These soils are too thin to be cultivated. They are used only for grazing, and they are better suited to grazing than to other purposes. Some areas are suited to wildlife.

The main need of management is controlling water erosion. Controlled grazing is needed to maintain a good vegetative cover to protect the surface layer from erosion.

CAPABILITY UNIT VIs-TC

This unit consists of nearly level and gently sloping soils of the Absher, Oburn, and Rhoades series. These soils have a surface layer of loam, silt loam, and silty clay loam. These soils have a claypan subsoil. More than 35 percent of the areas have a claypan within a depth of 5 inches or have a claypan that is exposed at the surface. In a few places roots of plants can penetrate the claypan subsoil only through the cracks in the claypan. Permeability is slow and very slow. Available water capacity is

low. Fertility is low. Organic-matter content is low to moderate. Water erosion is a severe hazard if the steeper areas are overgrazed or tilled.

These soils are not suited to cultivation. Areas that are now cultivated should be seeded to grass.

The main needs of management are maintaining organic-matter content and fertility and controlling water erosion. Controlled grazing is necessary to control erosion.

CAPABILITY UNIT VIs–VS

This unit consists only of the gently sloping to steep soils of the Wabek complex. These soils are shallow to gravel. They have a surface layer mainly of loam. Fertility is low, and organic-matter content is moderate. Available water capacity is very low. Permeability is very rapid. Water erosion is a hazard if these soils are overgrazed or tilled.

These soils are too thin and generally too steep to be cultivated. They are better suited to grazing than to other uses. Some areas are suited to wildlife.

Controlling water erosion is the main need of management. Controlled grazing is a way of maintaining enough vegetation to protect the soils from erosion.

CAPABILITY UNIT VIIe–Sw

This unit consists of gently sloping to very steep soils of the Cabba, Cabbart, Fleak, Wayden, and Yawdin series and of shale and sandstone outcrops. From 10 to 30 percent of the area is exposed shale, sandstone, or barren land. The soils range from sandy to clayey. Permeability ranges from rapid to slow. Available water capacity is low and very low. Fertility and organic-matter content are low. Water erosion is the main hazard. The main limitations are steepness and shallow depth of the soils.

These soils are too thin and too steep to be cultivated. They are suited to grazing. Most areas are suited to wildlife.

Controlling water erosion is the main need of management. Controlled grazing helps to maintain enough vegetation to protect the soils from further erosion.

CAPABILITY UNIT VIIs

This unit consists only of the gently sloping to very steep areas of Badland. Badland consists of soft bedrock of shale and sandstone and shallow soil material. From 30 to 85 percent of the areas are barren. Small areas of claypan soils and moderately deep and deep soils without claypans are in valleys. Badland has slopes of 3 percent to more than 50 percent.

Badland is not suited to cultivation. Accessibility for grazing is limited in places by steepness and rough relief. Most areas are suited to wildlife.

Controlled grazing helps to improve the stands of native grasses.

CAPABILITY UNIT VIIs–Cp

This unit consists of nearly level to strongly sloping soils of the Ekalaka, Ladner, and Sham series and of areas of Blown-out land and Gullied land. The soils have a surface layer of fine sandy loam, loam, or loamy fine sand. Numerous blowouts, dispersed areas, gullies, and irregular patches of exposed shale are throughout. Active erosion has cut many deep gullies. The gullies are from 1 to 15 feet deep and are as much as 100 feet wide. They are almost void of vegetation. Ekalaka, Ladner, and Sham soils have slow permeability, low to moderate available water capacity and organic-matter content, and low to medium fertility. Soil blowing and water erosion are the main hazards.

These soils are not suited to cultivation, because of the numerous blowouts and gullies and high susceptibility to water erosion and soil blowing. They are suited to grazing.

Controlling water erosion is the main need of management. Controlled grazing is needed to protect the soil from erosion.

CAPABILITY UNIT VIIs–SwC

This unit consists only of Dilts and Lisam clays, steep. The soils contain many shale outcrops. Reaction ranges from extremely acid to moderately alkaline in the soils. Vegetation is very sparse. Runoff is rapid to very rapid. Water erosion is the main hazard.

These soils are too shallow to be cultivated. They are suited to grazing and are used for this purpose. Some areas are suited to wildlife.

Controlling water erosion is the main need of management. Controlled grazing is needed so that vegetative cover remains to protect the surface layer from erosion.

CAPABILITY UNIT VIIs–Sl

This unit consists of nearly level to sloping, very stony soils of the Amor, Boxwell, Marmarth, and Reeder series. These soils have a surface layer of loam or silt loam that contains numerous stones. Permeability is moderate. Available water capacity is moderate to high. Organic-matter content is medium, and fertility is medium to high.

These soils are too stony to be cultivated. They are used for grazing, and they are well suited to this purpose.

Controlling erosion is the main need of management. Controlled grazing helps to maintain enough vegetation to protect the soil from erosion.

CAPABILITY UNIT VIIs–Sy

This unit consists only of nearly level to steep, very stony soils of the Flasher and Vebar series. These soils have a surface layer of loamy fine sand and fine sandy loam. The very stony surface layer prohibits the use of farm machinery. Flasher soils have low fertility and organic-matter content and very low available water capacity. Vebar soils have medium fertility, moderate organic-matter content, and low to moderate available water capacity. Permeability is moderately rapid and rapid in all the soils in this unit.

Controlling erosion is the main need of management. Controlled grazing helps to maintain enough vegetation to protect the soils from erosion.

CAPABILITY UNIT VIIs–VS

This unit consists of soils of the Brandenburg-Cabba complex, hilly. These soils have a surface layer mainly of loam and silt loam. Brandenburg soils have a porcellanite substratum, and Cabba soils have a soft, loamy bedrock substratum. Scoria (porcellanite) outcrops are in places.

Slope ranges from gently sloping to very steep. Permeability is moderate and rapid in the soils in this unit. Available water capacity is very low or low. Organic-matter content and fertility are low.

These soils are too shallow and too steep to be cultivated. They are better suited to grazing. Some areas are suited to wildlife.

The main limitations of these soils are shallow rooting depth and very low or low available water capacity. Controlled grazing helps to maintain enough vegetation to protect the areas from erosion.

CAPABILITY UNIT VIIIe

This unit consists of areas of Barren badland and Riverwash. Barren badland is steep and very steep. It has minor inclusions of shallow soils. There is little, less than 15 percent, or no vegetation on most of the areas of Barren badland. Water erosion is the main hazard. Slopes range from 3 to more than 50 percent. Accessibility to many areas of Barren badland for grazing is limited by steepness and a rough relief. Riverwash consists of deposits of sand, gravel, and some silt and clay that are in narrow strips along the rivers. It is flooded and reworked by water during flooding. It is subject to soil blowing, and few plants grow on it.

Some areas of this unit are suited to wildlife.

CAPABILITY UNIT VIIIs

This unit consists only of Mine dumps. This land type is made up of pits and trenches used for discarded refuse and debris. Vegetation is sparse on the piles of eroding waste.

Some areas are used for grazing. Most of the cave-ins and city dumps are idle. Accessibility for grazing is limited by irregular slopes and cave-ins.

Predicted yields

Table 2 gives the estimated yields per acre of crops grown under two levels of management for each soil mapped in the county. The yields shown in columns A are those expected under average management. The yields shown in columns B are those expected under the best techniques and management practices available.

Some farmers are now exceeding the yields estimated in columns B. It is expected that yields will increase in the future as improved varieties of plants are grown, new techniques are developed, and additional knowledge is gained from research and experience. To obtain the yields shown in columns B, erosion is controlled; the best varieties of seed are selected for planting, and seed of good quality is planted; a proper planting rate is used; weeds, insects, and diseases are controlled; tillage, seeding, and harvest operations are timely; the kinds and amounts of fertilizer applied are based on soil tests; and a good cropping system is used.

Range [3]

Range is a class of land that produces native vegetation of a kind and quantity suitable for grazing by wild or domestic animals. It is basically land that has never been cultivated but includes some revegetated cropland. These are "go-back" or fields on which native plants are reintroduced by artificial seeding. Range is a renewable natural resource that perpetuates itself under proper use and management. In Bowman County it is a resource of major economic importance.

The native vegetation produced on rangelands is not uniform throughout. It varies considerably from place to place because climax plant communities are very closely related to their natural environment, mainly the climate and soil. Management requirements differ between different kinds of range. It is therefore important to have a commonly accepted basis for classifying and evaluating the range resource.

Range sites and condition classes

A system has been developed for use by range managers whereby rangeland soils are grouped on the basis of similarity of qualities that affect their potential capacity to produce native vegetation. This grouping is called the range site. Range sites are distinctive kinds of rangeland that have different potential for producing native plant life. Each range site has its own combination of environmental factors that result in a plant community found only on that site.

Because of overgrazing, or for other reasons, in some areas the vegetation growing on rangeland is not equal to the potential for the site. Some plant species have decreased because of weakening through grazing pressures, others have increased, and in places still others that were not a part of the original plant community have invaded. In these areas, range vegetation is said to be lowered in condition. A system of evaluating rangeland by condition class has been developed for use in conservation and management programs. This classification is based on departure of the present vegetation from potential, or the climax, plant community for the site. The range condition class is a measure of quality of the plant cover currently occupying a given range site.

Departure of the plant cover from climax vegetation for the range site is indicated by what are termed condition classes within this system. Four range condition classes are recognized and defined for this purpose. Where the plant cover has deviated less than 25 percent from climax, the vegetation is indicated as *excellent* condition class. Other condition classes indicate a percentage of climax plant species in the present cover as follows: *good*, 51 to 75; *fair*, 26 to 50; and *poor*, 0 to 25.

Descriptions of the range sites

Many range sites make up the rangeland of Bowman County. Only a few of the original range soils are now of major importance, because some soils are mainly in cultivation. The others are of relatively minor importance. On the basis of a single ranch, however, any one site can be the major forage producer for the operating unit.

In this section the range sites are briefly discussed, and the most significant soil properties that govern the kind and proportion of plant species that make up the plant communities natural to these range sites are given. Also

[3] By CLAYTON L. QUINNILD, range conservationist, Soil Conservation Service.

TABLE 2.—*Estimated average acre yields of the principal crops grown under average and improved management* [1]

[Columns A list yields to be expected under average management, and columns B list yields that can be obtained under improved management. Dashes indicate that the crop is not suitable or ordinarily is not grown]

Soils	Wheat [2]		Oats		Barley		Alfalfa		Corn silage	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Alluvial land, saline										
Alluvial land, strongly saline										
Alluvial land, wet										
Amor loam, sloping	15	21	25	42	18	34	1.0	1.5	2.1	3.0
Amor-Cabba loams, strongly sloping	10	15	17	30	14	24	.8	1.1	3.0	4.0
Amor-Shambo loams, nearly level	16	22	27	44	20	35	1.2	1.8	4.0	5.0
Amor-Shambo loams, gently sloping	15	21	24	42	21	34	1.0	1.6	3.5	4.5
Arnegard loam, nearly level	20	27	34	54	28	43	1.3	1.9	4.5	5.5
Arnegard loam, gently sloping	19	24	32	48	27	38	1.1	1.7	4.0	5.0
Badland										
Barren badland										
Belfield silt loam, nearly level	15	20	26	40	20	32	1.0	1.4		
Belfield silt loam, gently sloping	14	18	24	36	20	29	.9	1.3		
Belfield silty clay loam, nearly level	15	20	26	40	20	32	1.0	1.4		
Belfield silty clay loam, gently sloping	14	17	24	34	20	27	.9	1.3		
Blown-out land										
Blown-out land-Ladner-Ekalaka complex										
Boxwell loam, sloping	13	16	22	32	18	26	1.0	1.8	2.5	3.0
Boxwell-Cabbart loams, strongly sloping	10	14	17	28	14	22	.7	.9	2.2	2.7
Boxwell-Kremlin loams, gently sloping	12	18	20	36	17	29	.9	1.2		
Brandenburg-Cabba complex, hilly	7	12	14	24	10	19	.6	.9	1.5	2.0
Cabba complex, sloping										
Cabba complex, steep	8	13	16	26	13	21	.7	1.9	1.6	2.1
Cabba-Amor loams, sloping										
Cabba-Amor loams, hilly										
Cabba-Wayden-Shale outcrop complex										
Cabba and Wayden stony soils										
Cabbart-Boxwell loams, sloping	8	12	14	24	13	19				
Cabbart-Boxwell loams, hilly										
Cabbart complex, steep										
Cabbart-Yawdim-Shale outcrop complex										
Chama and Morton silty clay loams, nearly level	15	24	26	48	21	38	1.3	1.8	4.0	5.0
Chama and Morton silty clay loams, gently sloping	13	20	22	40	18	32	1.2	1.7	3.5	4.5
Chama, Morton, and Cabba silty clay loams, sloping	12	18	20	36	17	29	1.0	1.4	3.0	3.7
Chanta loam, nearly level	12	16	20	32	17	26	.8	1.0	3.0	3.7
Chanta loam, gently sloping	10	14	16	28	11	22	.7	.9	2.5	3.0
Cherry clay loam, nearly level	15	20	25	40	18	32	.9	1.3		
Cherry clay loam, gently sloping	14	19	22	38	17	30	.8	1.2		
Cherry clay loam, sloping	12	18	20	36	15	29	.8	1.0		
Daglum fine sandy loam, gently sloping	6	12	13	24	10	19	1.0	1.4		
Daglum-Rhoades loams, nearly level	7	14	15	28	12	22	.7	1.0	3.0	3.5
Dilts and Lisam clays, rolling										
Dilts and Lisam clays, steep										
Ekalaka-Desart fine sandy loams, gently undulating	9	15	13	30	12	22	.8	1.0		
Ekalaka-Ladner complex, rolling	7	11	13	22	13	18	.9		2.5	3.0
Ekalaka-Zeona-Ladner loamy fine sands, gently sloping	9	14	17	28	15	22				
Flasher complex, steep										
Flasher-Vebar complex, hilly										
Flasher and Vebar very stony soils										
Fleak-Rhame complex, hilly										
Fleak rocky complex, steep										
Fleak-Tusler complex, steep										
Glendive fine sandy loam, nearly level	13	16	22	32	18	26	.9	1.1	3.5	4.5
Glendive fine sandy loam, undulating	11	14	19	28	15	22	.8	1.0	3.0	4.0
Grail silt loam, nearly level	20	27	34	54	28	43	1.3	1.9	4.5	5.5
Grail silt loam, gently sloping	18	24	31	48	25	38	1.1	1.7	4.0	5.0
Grail silty clay loam, nearly level	20	27	34	54	28	43	1.3	1.9	4.5	5.5
Grail silty clay loam, gently sloping	17	23	35	46	21	37	1.4	1.9	3.5	4.5
Grail soils, saline	9	12	13	24	14	19	1.7			
Grail-Rhoades silty clay loams, nearly level	15	19	26	38	21	20	1.0	1.3		
Grail-Rhoades silty clay loams, gently sloping	14	18	24	36	20	29	.9	1.2		
Gravel pit										
Hanly loamy fine sand										
Hanly soils, channeled										
Havre loam	16	21	27	42	22	34	1.1	1.5	3.5	4.5
Havre clay loam	17	22	29	44	24	35	1.1	1.5		

See footnotes at end of table.

TABLE 2.—*Estimated average acre yields of the principal crops grown under average and improved management* [1]—Continued

Soils	Wheat [2]		Oats		Barley		Alfalfa		Corn silage	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Korchea loam	18	24	31	48	25	38	1.4	1.8	4.0	5.0
Korchea clay loam, wet variant										
Korchea-Havre complex	17	23	28	46	24	37	1.1	1.5		
Korchea-Straw complex	18	24	32	48	25	38	1.4	1.9	4.5	5.5
Korchea and Havre soils, channeled										
Korchea and Straw soils, channeled										
Kremlin loam, nearly level	17	23	28	46	24	37	1.1	1.5	3.5	4.5
Kremlin loam, gently sloping	16	21	27	42	22	34	1.0	1.3	3.0	4.0
Kremlin-Belfield-Rhoades complex, nearly level	12	16	19	32	17	26	1.0	1.2		
Lawther silty clay	18	25	33	50	24	40	1.3	1.8		
Lawther-Rhoades silty clays	13	18	22	36	17	29	.9	1.1		
Lefor-Vebar fine sandy loams, gently sloping	12	18	23	36	16	27	.9	1.2	2.6	3.1
Lefor-Vebar fine sandy loams, sloping	11	16	21	32	16	24	.8	1.0	2.0	2.5
Lehr, Manning, and Wabek soils, sloping	11	14	17	26	13	19			2.5	3.0
Manning fine sandy loam, nearly level	13	16	22	30	18	24	.9	1.2	3.3	4.0
Manning fine sandy loam, gently sloping	8	13	15	24	12	19	.9	1.2	2.9	3.8
Marmarth loam, gently sloping	12	15	20	30	16	24	.9	1.1	3.0	4.0
Marmarth-Cabbart complex, sloping	10	17	17	34	15	27	.8	1.0	2.5	3.0
Marmarth-Rhame fine sandy loams, gently sloping	12	16	23	32	18	26	.8	1.0	2.5	3.0
Marmarth-Rhame fine sandy loams, sloping	12	15	20	30	17	24	.7	.9	2.5	3.0
Marmarth-Rhoades complex, nearly level	12	17	20	34	16	27	.9	1.2		
Marmarth-Rhoades complex, gently sloping	11	15	17	30	14	24	.8	1.0		
Marmarth-Rhoades complex, sloping	9	13	15	26	13	21	.7	.9		
Marmarth and Boxwell very stony loams										
McKenzie silty clay										
McKenzie and Heil silty clays										
Mine dumps										
Moreau silty clay, nearly level	13	20	18	40	18	32	.8	1.1	2.5	3.0
Moreau silty clay, gently sloping	11	17	19	34	15	27	.7	1.0	2.0	2.5
Moreau-Wayden silty clays, sloping	9	13	20	26	12	21	.6	.9	1.5	2.0
Oburn complex										
Parshall fine sandy loam, nearly level	14	20	24	40	20	32	1.1	1.5	3.0	4.0
Patent loam, gently sloping	11	16	19	32	15	26				
Patent loam, sloping										
Reeder-Cabba loams, sloping	12	18	20	36	17	29	1.0	1.5	3.0	4.0
Reeder-Rhoades complex, nearly level	13	19	21	38	17	30	1.0	1.3		
Reeder-Rhoades compex, gently sloping	12	17	20	34	17	27	.9	1.2		
Reeder-Rhoades complex, sloping	10	15	18	30	14	24	.8	1.1		
Reeder-Shambo loams, nearly level	17	24	29	48	24	38	1.3	1.8		
Reeder-Shambo loams, gently sloping	16	21	27	42	22	34	1.1	1.7		
Reeder and Amor very stony loams										
Regan silt loam	13	15	24	30	17	24	1.4	1.9		
Regent silty clay loam, nearly level	17	25	29	50	24	40	1.9	2.7	3.5	4.5
Regent silty clay loam, gently sloping	16	23	27	46	22	37	1.1	1.6	3.0	4.0
Regent-Moreau silty clay loams, sloping	12	19	22	38	18	30	1.0	1.5	2.5	3.0
Regent-Moreau-Rhoades complex, gently sloping	13	17	20	34	16	27	.9	1.2		
Regent-Rhoades complex, nearly level	14	19	24	38	20	30	1.0	1.3		
Rhame fine sandy loam, gently sloping	12	15	19	30	17	24	.8	1.1	2.3	2.8
Rhame-Fleak fine sandy loams, sloping	10	13	15	26	13	21			2.0	2.5
Rhame-Fleak fine sandy loams, hilly										
Rhoades-Absher complex, nearly level										
Rhoades-Absher complex, gently sloping										
Rhoades complex, terrace										
Riverwash										
Savage silty clay loam, nearly level	17	23	29	46	31	37	1.4	1.8	3.5	4.5
Savage-Rhoades silty clay loams, nearly level	13	18	22	36	23	29	1.0	1.3		
Searing loam, gently sloping	11	18	19	36	19	29	.9	1.2	3.5	4.5
Searing loam, sloping	9	15	16	30	16	23	.8	1.0		
Sham soils and Gullied land										
Shambo loam, nearly level	17	24	29	48	24	38	1.3	1.8	4.0	5.0
Shambo loam, gently sloping	16	23	27	46	22	37	1.2	1.7	3.5	4.5
Shambo-Arnegard loams, nearly level	18	25	31	50	25	40	1.3	1.9	4.5	5.5
Shambo-Arnegard loams, gently sloping	17	24	29	48	22	38	1.2	1.7	4.0	5.0
Shambo-Belfield-Rhoades loams, nearly level	13	18	22	36	17	29	1.0	1.3		
Stady loam, nearly level	13	17	22	44	17	35	1.0	1.3	4.0	5.0
Stady-Lehr loams, gently sloping	12	16	20	32	16	26	.9	1.1	3.5	4.5
Stady-Shambo loams, nearly level	14	19	24	38	20	30	1.3	1.8	4.0	5.0
Tally fine sandy loam, gently sloping	13	19	23	37	17	29	1.0	1.4	2.7	3.2

See footnotes at end of table.

TABLE 2.—*Estimated average acre yields of the principal crops grown under average and improved management* [1]—Continued

Soils	Wheat [2]		Oats		Barley		Alfalfa		Corn silage	
	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Tally fine sandy loam, sloping	11	15	19	30	15	24	0.9	1.3	2.2	2.7
Tally-Parshall fine sandy loams, nearly level	15	20	27	40	20	32	1.1	1.4	4.0	5.0
Telfer loamy fine sand	8	11	13	22	11	18	.7	1.0	2.1	2.6
Telfer-Flasher loamy fine sands, sloping										
Toby fine sandy loam, nearly level	14	18	24	36	20	29	.9	1.2	3.0	4.0
Toby fine sandy loam, gently sloping	13	17	22	34	18	27	.8	1.1	2.5	3.0
Toby fine sandy loam, sloping	12	16	20	32	17	26	.7	1.0	2.0	2.5
Toby loam, nearly level	15	21	26	42	21	34	1.0	1.4	4.0	5.0
Vebar-Flasher fine sandy loams, sloping	9	12	18	24	12	19	.8	1.2	2.0	2.5
Vebar-Flasher fine sandy loams, hilly										
Vebar-Tally fine sandy loams, gently sloping	12	15	17	30	14	24	.8	1.3	2.6	3.1
Velva fine sandy loam	14	20	24	40	20	32	1.0	1.6	3.0	3.5
Wabek complex										
Watrous loam	13	18	21	36	17	29	1.0	1.5		
Wayden-Moreau complex, sloping										
Wolf Point clay	16	20	20	40	20	32	1.0	1.4		
Yawdim silty clay, sloping										
Zeona fine sand, hummocky										
Zeona fine sand, undulating										
Zeona loamy fine sand, gently sloping	9	11	14	22	11	18	7	9	2.0	2.5
Zeona-Tusler loamy fine sands, sloping										

[1] About 75 to 95 percent of the hard spring wheat is grown on summer fallow.
[2] Hard spring wheat.

shown is the potential for total annual production of the site. These values are given on the basis of air-dry weight per acre for the growing season. Since the favorability of growing seasons normally varies from year to year, the production is presented in two figures to indicate these commonly occurring fluctuations.

The production figures show the entire production in a season of the complete plant cover occupying the site and are not intended to reflect amounts of grazable forage available to livestock. This means that all new growth on woody plants, regardless of their size, is also included. The production figures are based on a combination of measured samplings and estimates related to soils on which the values are known.

Some land types mapped in the survey area produce no significant amounts of native vegetation and are not classed as range sites. Among these land types are Gravel pits, Mine dumps, and Badlands. Badlands consists of areas of barren lands interspersed with vegetated areas that are suitable for grazing. The kinds of soils making up the vegetated parts of these areas and their total acreage is highly variable. They occur as soil areas described under the range sites listed in this section. An onsite determination is necessary to evaluate these areas for grazing.

Discussions of the individual range sites follow. They are listed according to their potential natural productivity.

WETLAND RANGE SITE

The soils in this site are variable in texture. They are alluvial soils that are affected by a strong inflow of seepage. They are mainly on bottom lands of drainageways. Variation of gradient on the bottoms of the channels results in poor surface drainage and significant ponding in places. The main soil feature responsible for the type of vegetation on this site is the abundant and consistent supply of water.

The principal forage-producing plants native to this site are prairie cordgrass and several species of medium-tall wetland sedges. A decline in range condition is indicated by the appearance of spike-sedge and several species of weedy forbs, such as cinquefoils and buttercups.

This site has the potential to produce about 3,500 to 4,000 pounds of air-dry herbage per acre during the normal growing season.

WET MEADOW RANGE SITE

The soils in this site are variable in texture. These soils are affected by moderately strong seepage. They are mostly on bottom lands of wide, low-gradient drainage channels or on flats near low hills capped by scoria or coarse-textured soils. The main soil features responsible for the type of plant cover natural to the site is the amount and consistency of soil moisture throughout the major part of the growing season.

The principal forage-producing plants native to this site are northern reedgrass, switchgrass, slim sedge, and wooly sedge. The vegetation is basically of a meadow type, but the dominant plants lack the size and proportion of species common to the Wetland range site.

Declining range condition is indicated by the increase or appearance of such plants as common spike-sedge, Baltic-rush, and several unpalatable forbs.

The site has the potential to produce about 3,000 to 3,500 pounds of air-dry herbage per acre during the normal growing season.

SALINE LOWLAND RANGE SITE

The soils in this site are variable in texture but are mostly silts and clays. They occupy the lower positions on the landscape and are affected by moderate to strong seepage of water high in salt content. Also in this site are some raw soils that receive continuing deposition from adjacent slopes. Some of the sediment carries a significant amount of mineral salts. The main soil feature responsible for the type of vegetation natural to this site is an accumulation of salts at the surface and throughout much of the rooting zone.

The principal forage species on this site are Nuttall alkaligrass, alkali cordgrass, and salt-tolerant species of slender wheatgrass and western wheatgrass. A decline in range condition generally is indicated by a large increase in inland saltgrass. Other salt-tolerant plants, such as foxtail barley and silverweed cinquefoil, increase greatly in places.

This site has the potential to produce about 1,900 to 2,600 pounds of air-dry herbage per acre during the normal growing season.

SANDS RANGE SITE

The soils in this site are loose and open, and take in surface water readily. Normal precipitation penetrates to a maximum depth of about 30 inches. This favors the taller growing grasses and forbs that root deeply, and these grasses are dominant in a plant cover that has a relatively minor amount of understory. The main soil feature responsible for the type of vegetation natural to this site is coarseness of texture and the soil properties associated with it.

The principal forage species native to this site are prairie sandreed and needle-and-thread. A decline in range condition is indicated by an increase in sun sedge and several species of weedy forbs, such as sageworts.

This site has the potential to produce about 1,400 to 1,900 pounds of air-dry herbage per acre during the normal growing season.

SANDY RANGE SITE

The soils in this site are moderately coarse textured and relatively open. Surface water is absorbed readily if the range is in excellent condition. Normal precipitation wets the soil to a maximum depth of about 25 inches. This favors the medium-tall grasses and forbs. They dominate in the climax plant cover. The main soil feature responsible for the type of vegetation on this site is the texture of the soils.

The principal forage species native to this site is needle-and-thread. Prairie sandreed, prairie junegrass, and sun sedge are important species. Declining range condition generally is indicated by an increase in blue grama, threadleaf sedge, and several species of unpalatable forbs, such as sagewort and goldenrod.

This site has the potential to produce about 1,300 to 1,800 pounds of air-dry herbage per acre during the normal growing season.

SILTY RANGE SITE

The soils in this site are medium textured. The rate of surface water intake is moderate, and controlling runoff is very important to high range condition. Normal precipitation wets the soil to a maximum depth of about 20 inches. Brief thundershowers wet only a few inches of the surface in many places. This favors a mixture of short and medium-tall grasses and sedges that have a large amount of forbs in similar proportion. The main soil features responsible for the type of vegetation native to this site are texture and permeability.

The principal forage species native to this site are western wheatgrass, needle-and-thread, prairie junegrass, and a variety of medium-tall forbs palatable to livestock. Blue grama, although it increases considerably under grazing pressure, is an important forage species. A decline in range condition generally is indicated by an increase in fringed sage.

This site has the potential to produce about 1,200 to 1,700 pounds of air-dry herbage during the normal growing season.

CLAYEY RANGE SITE

The soils in this site are mostly silty clay or silty clay loam in the surface layer or the subsoil. Maximum depth of wetting is about 16 inches from the normal pattern of precipitation. This favors short grasses and dryland sedges. The main soil features responsible for the type of plant cover natural to this site are fineness of particle size and soil-associated properties.

The principal forage species native to this site are western wheatgrass, plains reedgrass, and blue grama. Green needlegrass is important in places.

A decline in range condition is generally indicated by an increase in blue grama, needleleaf sedge, buffalograss, fringed sage, and such unpalatable forbs as hoods phlox, scarlet globemallow and wild parsley.

This site has the potential to produce about 1,100 to 1,600 pounds of air-dry herbage per acre during the normal growing season.

SHALLOW RANGE SITE

The soils in this site are limited in effective rooting depth because they are underlain by impermeable partly weathered sedimentary beds of shale or sandstone at a depth of 10 to 20 inches. This weathered material is generally soft and friable but has a platy structure that impedes root penetration. The main soil features responsible for the type of plant cover suited to this site is limited soil depth from which moisture and nutrients can be supplied.

The principal forage-producing plants native to this site are little bluestem, plains muhly, threadleaf sedge, thickspike wheatgrass, stiff sunflower, purple coneflower, and purple prairie-clover.

This site has the potential to produce about 1,000 to 1,300 pounds of air-dry herbage per acre during the normal growing season.

CLAYPAN RANGE SITE

The soils in this site have an impermeable subsoil that restricts the downward percolation of water and penetration of plant roots. Thickness of the permeable soil over the subsoil generally ranges from about 8 to 15 inches. The main soil feature responsible for the type

of vegetation native to this site is the limited depth of soil that permits free rooting by plants.

The dominant forage plant on this site is western wheatgrass. Where the surface layer is sand or of sandy texture, needle-and-thread makes up a high percentage of the plant cover. Blue grama is an important grass throughout this site, but it increases greatly if the site is overgrazed. Plains reedgrass and prairie junegrass are important in places. A decline in range condition is indicated by an increase in Sandberg bluegrass, scarlet globemallow, broom snakeweed, and pricklypear cactus.

This site has the potential to produce about 900 to 1,200 pounds of air-dry herbage per acre during the normal growing season.

SHALLOW CLAY RANGE SITE

The soils in this site have a high content of clay. They are underlain by slightly weathered shale beds at a depth of 10 to 20 inches. The underlying shale material is generally fractured and permits downward percolation of water, but it restricts penetration of plant roots. The main soil feature responsible for the plant cover natural to this site is the underlying shale.

The principal forage-producing plants adapted to this site are thickspike wheatgrass and western wheatgrass. Inland saltgrass is prevalent in spots. Plains reedgrass is important in places.

A decline in range condition generally is indicated by an increase in Sandberg bluegrass; such weedy species as broom snakeweed and wild parsley; and brush species, mainly big sagebrush and buckwheat brush. In some years annual weeds are prevalent on range in poor condition.

This site has the potential to produce about 850 to 1,100 pounds of air-dry herbage per acre during the normal growing season.

SHALLOW TO GRAVEL RANGE SITE

The soils in this site are medium textured. They are underlain by deposits of clean gravel at a depth of 10 to 20 inches. Plant roots are unable to grow into the gravel because of low available water capacity. The main soil feature responsible for the type of plant cover native to this site is droughtiness.

The principal forage-producing species is needle-and-thread. Other important forage plants are prairie junegrass and blue grama. A decline in range condition generally is indicated by an increase in red three-awn and several unplatable weedy plants, such as fringed sage, broom snakeweed, hoods phlox, scarlet globemallow, and rush skeletonplant.

This site has the potential to produce about 800 to 1,100 pounds of air-dry herbage per acre during the normal growing season.

VERY SHALLOW RANGE SITE

The soils in this site formed in medium-textured material, but they are underlain at a depth of less than 10 inches by solid or coarsely fractured rock, scoria, or clean gravel that restricts penetration of plant roots. The main soil feature responsible for the species of plants native to this site is the very limited amount of soil from which plants can extract moisture and nutrients.

The principal forage species suited to this site are needle-and-thread, little bluestem, plains muhly, blue grama, and threadleaf sedge. Bluebunch wheatgrass and thickspike wheatgrass are important in a few places but only on a limited scale. Needle-and-thread and blue grama are dominant on the soils underlain by gravel, and plains muhly and threadleaf sedge are dominant on the soils underlain by rock. A decline in range condition generally is indicated by an increase in unpalatable forbs, such as broom snakeweed and locoweed. If grazing is heavy on the soils that are shallow to gravel, fringed sage increases greatly.

This site has the potential to produce about 500 to 800 pounds of air-dry herbage per acre during the normal growing season.

THIN CLAYPAN RANGE SITE

The soils in this site have a very tight subsoil layer that is typically at a depth of 3 to 5 inches. This is the main soil feature responsible for the type of vegetation native to this site.

Blue grama intermixed with a sparse growth of western wheatgrass produces the major forage on this site. Buffalograss is prevalent in places, and Sandberg bluegrass is generally widespread. Pricklypear cactus is common, even where grazing is limited or absent.

A decline in range condition generally is indicated by an increase in Sandberg bluegrass and buffalograss and of unpalatable forbs adapted to the site. The amount of pricklypear generally increases as range condition declines. If this site is in poor condition, a significant percentage of the vegetation is generally made up of small annual weeds.

This site has the potential to produce about 400 to 600 pounds of air-dry herbage per acre during the normal growing season.

OVERFLOW RANGE SITE

The soils in this site are moderately well drained. These soils occupy low positions on the landscape. They are mostly on low terraces on flood plains along present-day streams or in swales and on the lower end of long slopes on uplands. The soils receive additional moisture in the form of runoff from other areas. The main soil feature responsible for the composition of the vegetative cover native to this site is the additional water normally available to plants.

The most important forage plants occupying this site are western wheatgrass, green needlegrass, slender wheatgrass, porcupinegrass, and a variety of medium-tall forbs.

Overflow sites associated with drainageways are places where grazing livestock tend to concentrate. The resulting excessive grazing pressure has thus contributed to an increase of brush species in some areas. Silver sagebrush is the most common woody increaser. Blue grama and small dryland sedges tend to increase readily on these soils because of heavy concentrations of grazing.

This site has the potential to produce about 1,800 to 2,400 pounds of air-dry herbage per acre during the normal growing season.

CLOSED DEPRESSION RANGE SITE

The soils in this site are in basins of varying size and depth, with a relatively narrow ratio of area contributing runoff to the size of the depression. The amount of inflow is, therefore, intermittent and highly variable, which is reflected by a pronounced inconsistency in the plant cover from one basin to another and from year to year. It is the main soil feature responsible for the plant species found in the climax vegetation of these areas.

The principal forage species native to this site is generally western wheatgrass. Other important species are prairie cordgrass, slender wheatgrass, and one or two species of medium-tall lowland sedges.

A decline in range condition is generally indicated by increases of foxtail barley, common spikesedge, and several species of weedy forbs, such as dock and cinquefoil.

The site has the potential to produce about 1,500 to 2,000 pounds of air-dry herbage per acre during a normal growing season.

THIN SANDS RANGE SITE

The soils in this site have a thin surface layer that contains some organic matter. They are largely single grain and loose. Water is taken in freely at the surface, and downward percolation is rapid within the soil. The soils are droughty, and fertility is low. The site occurs mostly as smooth, low, wind-deposited hills and as smooth upper slopes of sandstone ridges immediately below the Flasher or Fleak soils.

The principal forage species native to this site are much the same as those of the Sands range site, but they grow in a thinner stand and produce lower yields. A few less palatable species, such as sand dropseed, hairy goldaster, field sagewort, and stiff goldenrod, generally make up a considerable percentage of the total plant cover.

A decline in range condition is generally indicated by significant increases in weedy forbs.

This site has the potential to produce about 750 to 1,200 pounds of air-dry herbage per acre during the normal growing season.

Windbreaks [4]

Bowman County has approximately 1,800 acres of native woodland. Most of the tree and shrub species grow on the bottom lands adjacent to the main streams and rivers or on the north-facing slopes of drainageways. Cottonwood, green ash, boxelder, buffaloberry, chokecherry, and wild plum are the main deciduous species. These trees grow on both the bottom lands and on north-facing slopes. Rocky Mountain juniper and ponderosa pine are the main coniferous species. They grow only in the western part of the county. One area of approximately 1,000 acres is in the Dilts-Lisam-Shale outcrop soil association. Other small areas of these coniferous species are on some of the north-facing slopes adjacent to streams and rivers.

The early settlers used the trees for lumber, fence posts, and fuel. Today, however, the main uses for native trees and shrubs are for livestock protection, wildlife, recreation, esthetics, erosion control, and watershed protection.

Windbreaks have been planted since the days of the early settlers. Generally, the early plantings were for the protection of the farmstead and livestock. This is also true today, and there is still a need for these types of plantings around many of the farmsteads. Interest in the planting of field windbreaks to help control soil erosion on cultivated soils where there is a serious hazard of soil blowing is increasing. Thousands of acres of soils in the county need some form of protection from the wind.

Windbreaks return many economic and environmental benefits to the landowner. They distribute and hold snow, which prevents it from becoming a concern around the farmstead, and they protect the home and livestock from cold winter winds. They protect field crops, gardens, and orchards from strong damaging winds. They reduce evaporation of moisture. They provide a suitable habitat for many kinds of birds and other wildlife. They help to control soil erosion. They enhance the beauty of the rural home and its surroundings.

Items to consider before a windbreak is planted are (1) purpose of the planting, (2) suitability of the soils, (3) adaptability of trees and shrubs, and (4) location and design of the windbreak. Improperly designed windbreaks can cause many problems.

Establishment of a windbreak and continued growth of the trees depend upon careful selection, suitable preparation, and adequate maintenance of the site. Grass and weeds have to be eliminated before the trees are planted, and regrowth of the ground cover should be controlled for the entire life of the windbreak. Some replanting is likely to be needed in the first and second years.

Table 3 lists most of the tree and shrub species used in windbreak plantings. The table gives the actual or estimated average height of growth and the vigor of the various species at 20 years of age. The rating in the vigor column refers to the density of foliage, the freedom from damage from insects or disease, and the general appearance of the tree. All height measurements and vigor ratings are based on well-managed plantings.

A plant that has a rating of *good* for vigor generally exhibits one or more of the following conditions: leaves or needles are normal in color and growth; small amounts of deadwood (tops, branches, and twigs) occur within the live crowns; evidence of disease, insects, or climatic damage is limited; and evidence of stagnation or suppression is slight.

A plant that has a rating of *fair* exhibits one or more of the following conditions: leaves or needles are obviously abnormal in color and growth; substantial amounts of deadwood (tops, branches, and twigs) are within the live crowns; evidence of moderate disease, insect, or climatic damage is obvious; definite suppression or stag-

[4] By DAVID L. HINTZ, woodland conservationist, Soil Conservation Service.

TABLE 3.—*Height and vigor of trees and shrubs by windbreak suitability group* [1]

[Groups 8 and 9 are undesirable for trees and shrubs; group 10 is undesirable for trees and shrubs where optimum vigor and growth are required]

Species	Windbreak suitability group—											
	1		3		4		5		6		7	
	Vigor	Height	Vigor	Height	Vigor	Height	Vigor	Height	Vigor	Height	Vigor	Height
		Ft.		*Ft.*		*Ft.*		*Ft.*		*Ft.*		*Ft.*
American elm	Good	17–20	Good	16–20	Fair	12–13	Fair	13–15	Poor	-------	Poor	-------
Black Hills spruce	Good	15–18	Fair	14–17	Poor	-------	Poor	-------	Poor	-------	Poor	-------
Caragana	Good	7–9	Good	8–9	Fair	4–5	Good	7–8	Fair	5–7	Fair	4–5
Chokecherry	Good	9–11	Good	8–9	Good	7–8	Fair	6–8	Poor	-------	Fair	4–5
Colorado blue spruce	Good	15–18	Fair	14–17	Poor	-------	Poor	-------	Poor	-------	Poor	-------
Cottonwood	Fair	36–43	Poor	-------	Poor	-------	Poor	-------	Poor	-------	Poor	-------
Eastern redcedar	Good	9–11	Good	9–11	Fair	8–9	Good	7–9	Fair	6–8	Fair	6–8
Green ash	Good	17–20	Good	16–20	Fair	13–14	Fair	13–15	Fair	11–14	Poor	-------
Honeysuckle	Good	7–9	Good	6–8	Fair	5–7	Fair	5–6	Poor	-------	Poor	-------
Ponderosa pine	Good	15–19	Good	15–19	Poor	-------	Good	15–18	Fair	10–12	Fair	10–12
Rocky Mountain juniper	Good	9–11	Good	9–11	Fair	8–9	Good	7–9	Fair	6–8	Fair	6–8
Russian-olive	Good	11–15	Good	12–14	Fair	9–11	Fair	11–13	Fair	10–12	Poor	-------
Siberian elm	Good	22–26	Good	20–25	Fair	15–19	Good	20–22	Fair	15–19	Poor	-------
Wild plum	Good	5–6	Good	6–7	Good	5–6	Fair	4–5	Poor	-------	Poor	-------

[1] Height measurements and vigor ratings are for trees at 20 years of age.

nation exists; and the current year's growth is obviously less than normal.

A plant that has a rating of *poor* exhibits one or more of the following conditions: leaves or needles are very abnormal in color and growth; very large amounts of deadwood (tops, branches, and twigs) are within the live crowns; evidence of extensive disease, insect, or climatic damage is obvious; plants show the effects of severe stagnation, suppression, or decadence; and the current year's growth is essentially negligible. Plants that have this rating are not recommended for farmstead, feedlot, or field windbreaks. They are satisfactory for some wildlife and beautification plantings in places.

Windbreak suitability groups

The soils of North Dakota have been placed into 10 windbreak suitability groups. All of these groups except group 2 are represented in Bowman County. The growth response for suited trees and shrubs is generally the same for all of the soils within a group if good management practices are applied.

Several factors are considered in placing soils into windbreak suitability groups, but the dominant and most critical factor is the amount and seasonal availability of soil moisture to trees. Hence, most groups have soils that have a rather wide range of slope and texture of the surface layer. These two soil characteristics largely determine the degree of hazard of water erosion and soil blowing. Degree of slope also determines need for water and soil conservation practices on soils that have no other limiting characteristics for suitability.

The degree of susceptibility to soil blowing for various textured phases of soils used for windbreaks are: (1) coarse textured, very serious, (2) moderately coarse textured, serious, (3) medium textured, moderate to slight, (4) moderately fine textured, slight, and (5) fine textured, serious. The degree of susceptibility to water erosion for various slope phases of soils used for windbreaks are (1) 0 to 3 percent, none to slight, (2) 3 to 6 percent, moderate, (3) 6 to 9 percent, serious, (4) 9 to 12 percent, serious to very serious, and (5) 12 percent and more, very serious.

All soils suited to and planted to windbreaks and having slopes of more than 6 percent need water conservation practices for satisfactory tree growth. All soils on which there are hazards of soil blowing or water erosion need specialized site preparation and planting and cultivation practices to successfully establish and maintain plantings. The water table is beyond the reach of tree roots on all soils in groups 3 to 10, except for several soils in group 10. These soils are very wet during at least part of the year, and a few have additional limitations critical for growing trees and shrubs.

Gravel pits, Mine dumps, and Riverwash are not rated in table 3. These land types are so variable in soil characteristics that a rating is not feasible. They are suited to spot plantings for wildlife, recreational, and beautification purposes in selected locations.

WINDBREAK SUITABILITY GROUP 1

In this group are the nearly level to gently sloping soils of the Arnegard, Glendive, Grail, Havre, Korchea, Parshall, Straw, Velva, and the Wolf Point series. These soils are deep and moderately deep and well drained. Texture ranges from sandy loam to silty clay. The surface layer is neutral to moderately alkaline. Water erosion is not a hazard, because of slow runoff. The Glendive, Parshall, Velva, and Wolf Point soils are highly susceptible to soil blowing. All of the soils in this group have favorable moisture for survival and growth of trees and shrubs. The water table is within the reach of

tree roots, or the soils receive additional moisture through runoff from higher lying areas.

These soils are well suited to all types of windbreak plantings. There is no serious limitation to the planting of trees and shrubs, except that some of the soils are highly susceptible to soil blowing.

WINDBREAK SUITABILITY GROUP 3

In this group are the nearly level to strongly sloping soils of the Amor, Boxwell, Cherry, Kremlin, Marmarth, Morton, Patent, Reeder, Regent, Savage, and Shambo series. These soils are deep and moderately deep and well drained. They have a loamy texture. Water erosion is a hazard on many of these soils. The hazard of soil blowing is moderate on all of the soils in this unit, except the Cherry, Regent, and Savage soils. The hazard of soil blowing is slight on these soils. Where slopes are more than 6 percent, moisture conservation is needed for trees and shrubs to grow satisfactorily. The water table is beyond the reach of tree roots in all of these soils.

These soils are well suited to all types of windbreaks and plantings. With the exception of those soils on which soil blowing or water erosion are hazards, there are no other limitations to the planting of trees and shrubs.

WINDBREAK SUITABILITY GROUP 4

In this group are the nearly level to sloping soils of the Belfield, Desart, Lawther, Moreau, and Rhoades series. These are deep or moderately deep, well-drained or moderately well drained, loamy or clayey soils that have a clayey subsoil. These soils are highly susceptible to water erosion and soil blowing.

These soils are suited to all types of windbreaks and plantings if selection of species is proper. The number of tree and shrub species that perform well on these soils is limited. Optimum survival, vigor, growth, and longevity should not be expected. The critical limitation is the clayey texture of the subsoil.

WINDBREAK SUITABILITY GROUP 5

In this group are the nearly level to hilly soils of the Lefor, Rhame, Tally, Toby, and Vebar series. These are deep or moderately deep, well-drained, loamy soils. Most of the precipitation is absorbed by these soils, but some is lost through runoff during heavy storms. Available water capacity generally is moderate, but it is low to moderate in Lefor, Rhame, and Vebar soils. The soils in this group are highly susceptible to water erosion and soil blowing.

These soils are suited to all types of windbreaks and plantings if selection of species is proper. The number of species that perform well on these soils is limited. Only adapted species should be planted. The main limitation on these soils is available water capacity.

WINDBREAK SUITABILITY GROUP 6

In this group are the nearly level to sloping soils of the Chanta, Lehr, Manning, Searing, Stady, and Watrous series. These soils are shallow to moderately deep to sand, gravel, porcellanite, or bedrock. They are well drained to excessively drained, and loamy. Most of the precipitation is absorbed by these soils, but it moves rapidly through the underlying sand and gravel. Available water capacity generally is low, but it is low to moderate in Searing soils. These soils are susceptible to water erosion and soil blowing.

These soils are poorly suited to all types of windbreaks and plantings. Plantings can be established if site selection is proper and where optimum survival, growth, and vigor are not required or expected. Low available water capacity and a restricted rooting zone are the critical limitations.

WINDBREAK SUITABILITY GROUP 7

In this group are the nearly level to strongly sloping and hilly soils of the Hanly, Rhame, Telfer, and Vebar series. These soils generally are deep, sandy, and somewhat excessively drained or excessively drained, but Rhame and Vebar soils are moderately deep, loamy, and well-drained. Most of the precipitation is absorbed by these soils, but little is retained. These soils have very low or low available water capacity, and they are highly susceptible to soil blowing.

These soils are suited to wildlife, recreation, and beautification plantings where optimum survival, growth, and vigor are not required or expected. The selection of species is very limited. The soils are poorly suited to field windbreaks. Low available water capacity is the critical limitation.

WINDBREAK SUITABILITY GROUP 8

In this group are the gently sloping or sloping soils of the Cabba, Cabbart, Chama, Wayden, and Yawdim series. These soils are shallow to moderately deep and well drained. They are generally loamy, but Wayden soils are clayey. Most of the precipitation runs off these soils. These soils have low to moderate available water capacity.

These soils are not suitable for field windbreaks. They are suitable for wildlife, recreational, and beautification plantings where optimum survival, growth, and vigor are not required or expected.

WINDBREAK SUITABILITY GROUP 9

In this group are the level to sloping soils of the Absher, Daglum, Ekalaka, Ladner, Oburn, and Rhoades series. These soils are deep or moderately deep, well drained, moderately well drained, or poorly drained, and they have a dense claypan subsoil. A nonsodic and nonsaline root zone is generally less than 20 inches thick. Available water capacity is low or moderate. The hazard of soil blowing is slight, and the hazard of water erosion is slight to serious.

These soils are not suited to any type of windbreak plantings. They are in a complex with soils suitable for trees and shrubs. The other soils in the complex are suited to planting of trees and shrubs for wildlife or recreation. The main limitation is the dense claypan that restricts root growth. Other limitations are moderate or low available water capacity and salt toxicity.

WINDBREAK SUITABILITY GROUP 10

In this group are the gently sloping to steep and hummocky soils of the Brandenburg, Cabba, Cabbart,

Dilts, Flasher, Fleak, Heil, Lisam, McKenzie, Regan, Sham, Tusler, Wabek, Wayden, Yawdim, and Zeona series. Also in this group are the land types Alluvial land, saline; Alluvial land, wet; Badland; Barren badland; Blown-out land; Gullied land; Gravel pit; Mine dumps; Riverwash; and Shale outcrop. In addition, it includes Grail soils, saline; Korchea clay loam, wet variant; and stony phases of the Amor, Boxwell, Cabba, Flasher, Marmath, Reeder, Vebar, and Wayden series.

These soils vary in texture and slope. They generally are too shallow, too stony or rocky, and too steep for the use of machinery needed to plant trees and shrubs. They also are too droughty, wet, clayey, or salty for good survival and growth of plantings. Other limitations for some soils are low fertility, an impermeable substratum, extreme denseness or compactness of the subsoil, or insufficient soil material for rooting and growth.

Many of the soils in this group are unsuitable for any type of tree and shrub plantings. If proper care is given to the selection of planting site and tree and shrub species, however, plantings for various purposes can be established on some soils. On those soils that can support trees and shrubs, highly specialized planting, cultivation, and site preparation practices are needed in places. Optimum survival, vigor, and growth should not be required or expected.

Use of Soils for Wildlife [5]

The wildlife resources of Bowman County provide the bulk of outdoor recreation for people in the area. Most of the original wildlife resources have been retained in the county since the advent of ranching and farming. Ranching, in particular, has retained the most important native wildlife species.

[5] By ERLING B. PODOLL, biologist, Soil Conservation Service.

Important local species are the sharp-tailed grouse, sage grouse, antelope, white-tailed deer, mule deer, and pheasant, which has been introduced. The production of mourning dove in the county is excellent, and these birds provide an excellent opportunity for hunting.

Because suitable habitat is lacking or climatic factors are adverse, gray partridge, wild turkey, mink, and ducks have small chance of reaching high populations.

Mammals in the county that provide fur and recreation are the long-tailed weasel, beaver, skunk, badger, red fox, fox squirrel, coyote, white-tailed jackrabbit, cottontail rabbit, and bobcat.

Among the many species of birds in the county are eagles, hawks, owls, insectivorous birds, and songbirds. Most of them are of great economic importance because they keep down the populations of small rodents and insects.

This section discusses the suitability of the soil associations in the county for important species of wildlife. Each soil association has a different capability for producing the type of habitat needed by different species. Table 4 is a guide to the expected results when developing or managing land as habitat for pheasant, sharp-tailed grouse, sage grouse, antelope, and deer. Suitability of the soils for wildlife habitat is rated *poor*, *fair*, or *good*. A rating of *good* for a certain species means that it is relatively easy to develop the habitat or to manage it for increased production.

Farmers or ranchers who intend to improve the habitat on their land should first inventory and evaluate the habitat to insure that the right habitat is planned and the year-round needs are identified. Once needs have been identified, the correct management, the proper vegetation, or the practice best suited to that particular soil or field area can be selected. Other sections of this survey provide guidance to the suitability of the soils for the establishment of vegetation, such as grasses, legumes, shrubs, and trees or for installing engineering works.

TABLE 4.—*Wildlife interpretations by soil associations*

[The columns headed "Potential" refer to the potential breeding population per square mile; the columns headed "Habitat" refer to the suitability of the association for the development of wildlife habitat]

Soil association	Pheasant		Sharp-tailed grouse		Sage grouse		Antelope		Deer	
	Potential	Habitat	Potential	Habitat	Potential	Habitat	Potential	Habitat	Potential	Habitat
	Number		*Number*		*Number*		*Number*		*Number*	
1. Amor-Reeder-Cabba	25–100	Good	0–2	Poor	0–2	Poor	0–1	Poor	0–1	Poor.
2. Regent-Moreau-Cabba	25–100	Good	0–2	Poor	0–2	Poor	0–1	Poor	0–1	Poor.
3. Cabbart-Absher	6–24	Fair	7–30	Good	3–6	Fair	2–4	Fair	5–30	Good.
4. Dilts-Lisam-Shale outcrop	0–5	Poor	7–30	Good	3–6	Fair	5–10	Good	5–30	Good.
5. Cabbart-Badland-Yawdim	0–5	Poor	3–6	Fair	3–6	Fair	2–4	Fair	5–30	Good.
6. Reeder-Brandenburg-Cabba	0–5	Poor	0–2	Poor	0–2	Poor	2–4	Fair	2–4	Fair.
7. Cabba-Amor-Chama	6–24	Fair	7–30	Good	0–2	Poor	5–10	Good	2–4	Fair.
8. Vebar-Flasher	6–24	Fair	3–6	Fair	0–2	Poor	2–4	Fair	2–4	Fair.
9. Rhame-Fleak	6–24	Fair	3–6	Fair	0–2	Poor	2–4	Fair	2–4	Fair.
10. Ekalaka-Rhame-Zeona	0–5	Poor	7–30	Good	7–30	Good	5–10	Good	5–30	Good.
11. Havre-Toby-Glendive	6–24	Fair	3–6	Fair	7–30	Good	2–4	Fair	5–30	Good.
12. Korchea-Straw	25–100	Good	0–2	Poor	0–2	Poor	0–1	Poor	5–30	Good.
13. Belfield-Rhoades-Amor	25–100	Good	0–2	Poor	0–2	Poor	0–1	Poor	2–4	Fair.
14. Rhoades-Moreau	6–24	Fair	3–6	Fair	3–6	Fair	5–10	Good	2–4	Fair.
15. Rhoades-Absher	6–24	Fair	3–6	Fair	3–6	Fair	5–10	Good	2–4	Fair.

The suitability of the habitat determines wildlife population levels. The suitability generally depends on the amount and kind of vegetation present. The amount, kind, and distribution of a given habitat is determined by land use and management, both of which are limited to some extent by the soils in that area. The ratings given in table 4 are based on present land use and on the potential of a given soil association for the establishment or maintenance of suitable habitat.

In the following paragraphs the most important species of wildlife in the county are briefly discussed, and the soil associations that have the highest potential for suitable habitat are identified.

Mule deer are fairly well distributed throughout the county, especially in summer. White-tailed deer are restricted, especially in winter, to the more heavily wooded areas, such as those along Little Beaver Creek and Cedar Creek. Soil associations that have the highest potential for mule deer are Havre-Toby-Glendive, Korchea-Straw, Dilts-Lisam-Shale outcrop, Ekalaka-Rhame-Zeona, Cabbart-Absher, and Cabbart-Badlands-Yawdim. These associations have the greatest potential for furnishing year-round food and cover.

Sharp-tailed grouse are suited to native range. This species prefers grassland that has a good interspersion of shrubs, thickets, or even fairly large woody tracts. The largest sharp-tailed grouse populations can be attained in the Cabba-Amor-Chama, Dilts-Lisam-Shale outcrop, Ekalaka-Rhame-Zeona, and Cabbart-Absher soil associations.

The ring-necked pheasant is important in Bowman County. Because of the entrenched drainages and relatively mild winters, these birds survive well, but they are vulnerable to winter storms, which reduce their population. Soil associations that have the best potential for pheasant are the Amor-Reeder-Cabba and Korchea-Straw associations.

Sage grouse is a native species that inhabits the natural sagebrush-grassland community. It is dependent on the residual cover and entirely dependent on sagebrush for food. Soil associations that have the best potential for sage grouse are the Havre-Toby-Glendive and Korchea-Straw associations.

The pronghorn antelope also inhabits the sagebrush-grassland community. Generally, it is not practical to let the populations get too large where intensive farming is practiced, because the antelope damage crops. Under present land-use conditions, the soil associations that have the highest potential for antelope are the Cabba-Amor-Chama, Dilts-Lisam-Shale outcrop, Ekalaka-Rhame-Zeona, and Rhoades-Moreau associations.

No natural lake fisheries are in the county, but some stream fishing is done in spring and in summer in the Little Missouri River. Three water developments are suitable for fish, and they have been developed. The county has a good potential for constructing dams for fisheries. The soil associations that have the best potential for fish ponds are the Amor-Reeder-Cabba, Vebar-Flasher, Belfield-Rhoades-Amor, and Rhoades-Moreau associations. It is important to select sites that will not receive excessive sediment.

Cropland and range commonly provide desired wildlife habitat, and under proper management they produce good wildlife populations. If they do not produce the desired populations, other management practices or special practices that primarily benefit wildlife are likely to be needed. Assistance needed in evaluating land for wildlife needs and applying wildlife or other management practices can be obtained from the local office of the Soil Conservation Service or from the Game and Fish Department.

Engineering Uses of the Soils [6]

Some soil properties are of interest to engineers because they affect construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, irrigation and drainage systems, and sewage disposal systems. Among the properties most important to engineers are permeability to water, shear strength, compaction characteristics, drainage, shrink-swell properties, texture, plasticity, and reaction. Other important properties are depth to water table, depth to bedrock, available water capacity and relief. Test data of selected soils are given in table 5, estimates of soil properties significant to engineering are given in table 6 for all soils, and interpretations relating to engineering uses of the soils are given in table 7.

The information in this section can be used to—

1. Make studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of soil properties that are significant in the planning of agricultural drainage systems, farm ponds, irrigation systems, and diversions and terraces.
3. Make preliminary evaluations of soil and ground conditions that aid in selecting locations for highways, airports, pipelines, and cables and in planning detailed investigations at the selected locations.
4. Locate probable sources of gravel, sand, and other construction materials.
5. Correlate performance of engineering structures with soil mapping units to develop information for overall planning that is useful in designing and maintaining engineering structures.
6. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
7. Supplement the information obtained from other published maps and reports and aerial photographs for the purpose of making soil maps and reports that can be used readily by engineers.
8. Develop other preliminary estimates for construction purposes pertinent to the particular area.

Using the soil map for identification, the engineering interpretations reported here can be useful for many purposes. It should be emphasized, however, that they do not eliminate the need for sampling and testing at the site of specific engineering works that involve heavy loads and

[6] By CLINTON R. JOHNSON, State conservation engineer, Soil Conservation Service.

TABLE 5.—*Engineering*

[Tests performed by North Dakota State University in cooperation with North Dakota State Highway Department and the Bureau

Soil name and location	Parent material	North Dakota report number	Depth from surface	Moisture-density [1]	
				Maximum dry density	Optimum moisture
			In.	*Lb. per cu. ft.*	*Pct.*
Amor loam:					
340 feet W. and 190 feet N. of S. quarter corner of sec. 2, T. 131 N., R. 103 W. (Modal)	Soft shale, siltsone, and fine-grained sandstone.	89	8–12	113. 0	13. 6
		90	12–19	110. 0	14. 4
		91	31–41	111. 3	13. 5
90 feet E. and 1,408 feet N. of SW. corner of sec. 16, T. 129 N., R. 99 W. (Finer textured in substratum than modal)	Soft shale, siltstone, and fine-grained sandstone.	75	6–13	113. 2	14. 2
		76	19–26	110. 0	15. 0
		77	44–60	107. 0	18. 2
Cabbart loam:					
110 feet W. and 240 feet N. of SE. corner of sec. 15, T. 129 N., R. 104 W. (Modal)	Soft shale, siltstone, and fine-grained sandstone.	116	7–14	103. 0	19. 0
		117	20–51	108. 0	16. 5
Cabba loam:					
260 feet W. and 60 feet N. from center of sec. 25, T. 129 N., R. 100 W. (Modal)	Soft shale, siltstone, and fine-grained sandstone.	64	7–15	102. 0	19. 0
		65	29–38	99. 8	22. 0
584 feet W. of S. quarter corner of sec. 1, T. 131 N., R. 99 W. (Coarser textured than modal)	Soft shale, siltstone, and fine-grained sandstone.	85	6–15	102. 0	18. 5
		86	22–29	103. 0	18. 0
Lisam clay:					
1,584 feet E. and 726 feet N. of W. quarter corner of sec. 20, T. 130 N., R. 106 W. (Modal)	Soft shale.	104	12–20	94. 0	25. 4
		105	20–30	94. 3	25. 6
Reeder loam:					
1,066 feet N. and 475 feet W. of E. quarter corner of sec. 14, T. 129 N., R. 100 W. (Modal)	Soft shale, siltstone, and fine-grained sandstone.	101	8–12	104. 2	18. 6
		102	16–28	107. 0	17. 0
		103	40–48	105. 8	18. 0
84 feet S. and 156 feet W. of NE. corner of SE. quarter of sec. 20, T. 129 N., R. 100 W. (Slightly finer textured throughout than modal)	Soft shale, siltstone, and fine-grained sandstone.	69	6–11	113. 0	14. 0
		70	16–25	105. 6	18. 5
		71	38–47	107. 0	17. 5
Regent silty clay loam:					
155 feet E. and 350 feet N. of W. quarter corner of sec. 13, T. 131 N., R. 99 W. (Modal)	Soft shale.	82	8–19	99. 5	20. 4
		83	26–37	100. 3	19. 0
		84	45–60	102. 0	20. 0
210 feet E. and 64 feet N. of SW. corner of sec. 30, T. 132 N., R. 100 W. (Unlike modal, calcareous to the surface)	Soft shale.	95	7–13	101. 4	20. 3
		96	13–23	101. 6	19. 8
		97	33–39	103. 0	19. 0
105 feet S. and 910 feet E. of W. quarter corner of sec. 27, T. 132 N., R. 100 W. (Finer textured substratum than modal)	Soft shale.	118	8–16	102. 0	19. 4
		119	23–27	103. 5	20. 0
		120	34–42	100. 0	21. 0
Rhoades loam:					
185 feet W. and 840 feet S. of E. quarter corner of sec. 34, T. 130 N., R. 104 W. (Modal)	Soft shale.	98	6–12	101. 4	18. 0
		99	17–24	108. 5	18. 0
		100	24–35	111. 4	15. 8
225 feet W. and 375 feet S. of E. quarter corner of sec. 3, T. 131 N., R. 103 W. (Deeper to bedrock than modal)	Soft shale.	92	6–10	97. 0	22. 0
		93	10–19	101. 0	20. 2
		94	24–30	107. 5	16. 0
99 feet S. of E. quarter corner of sec. 17, T. 132 N., R. 106 W. (Finer textured substratum than modal)	Soft shale.	111	5–9	102. 8	16. 9
		112	22–29	108. 8	14. 8
		113	37–43	99. 6	20. 0

See footnotes at end of table.

test data

of Public Roads (BPR) in accordance with standard procedures of the American Association of State Highway Officials (AASHO)]

Mechanical analysis [2]								Liquid limit	Plasticity index	Classification	
Percentage passing sieve— [3]				Percentage smaller than—							
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	(0.05 mm.)	(0.02 mm.)	(0.005 mm.)	(0.002 mm.)			AASHO	Unified
								Pct.			
100	100	99	59	48	29	19	14	(4)	(4)	A-4(5)	ML
100	99	98	58	48	30	20	15	(4)	(4)	A-4(5)	ML
100	100	99	39	31	21	14	10	(4)	(4)	A-4(1)	SM
100	100	99	52	44	31	24	20	25	4	A-4(3)	ML-CL
100	100	99	68	60	45	30	22	28	10	A-4(7)	CL
100	100	100	95	90	76	48	33	42	23	A-7-6(14)	CL
100	100	99	95	72	39	25	18	(4)	(4)	A-4(8)	ML
100	100	100	95	69	35	21	15	33	8	A-4(8)	ML
100	100	100	94	75	39	25	21	40	12	A-6(9)	ML
100	100	100	94	90	71	51	38	49	23	A-7-6(15)	CL
100	100	100	45	37	28	25	23	41	12	A-7-6(3)	SM
100	100	100	49	40	29	25	21	37	13	A-6(4)	SM or SC
100	99	98	97	97	94	79	64	74	39	A-7-5(20)	MH-CH
100	92	92	91	89	85	73	58	74	49	A-7-6(20)	CH
100	100	100	65	56	38	28	24	33	11	A-6(6)	CL
100	100	98	64	52	36	28	22	32	10	A-4(6)	ML-CL
100	100	100	62	48	32	27	23	36	12	A-6(6)	ML-CL
100	99	98	94	70	36	26	24	27	11	A-6(8)	CL
100	100	99	57	50	40	34	27	41	19	A-7-6(8)	CL
100	100	99	62	53	40	32	26	41	23	A-7-6(11)	CL
100	99	99	95	87	69	46	37	42	17	A-7-6(11)	ML-CL
100	100	100	91	91	73	47	36	50	28	A-7-6(17)	CH
100	100	99	96	90	75	53	41	49	25	A-7-6(16)	CL
100	100	100	94	86	69	49	36	43	18	A-7-6(12)	ML-CL
100	100	100	97	92	79	54	41	49	27	A-7-6(17)	CL
100	100	100	98	85	54	33	28	48	27	A-7-6(16)	CL
100	100	100	95	89	75	54	41	46	22	A-7-6(14)	CL
100	100	95	89	87	80	57	46	47	23	A-7-6(15)	CL
100	100	100	99	98	94	74	62	60	34	A-7-6(20)	CH
100	98	96	81	73	55	38	30	43	26	A-7-6(15)	CL
100	100	99	95	90	76	48	38	39	13	A-6(9)	ML-CL
100	100	100	98	88	62	36	29	34	12	A-6(9)	ML-CL
100	100	99	83	76	63	53	46	47	21	A-7-6(14)	ML-CL
100	100	100	79	72	58	48	42	44	20	A-7-6(13)	ML-CL
100	100	100	56	50	40	34	29	36	17	A-6(7)	CL
100	99	99	70	60	45	34	29	36	14	A-6(9)	CL
100	100	99	75	63	43	34	28	38	17	A-6(11)	CL
100	100	100	91	78	57	42	36	56	30	A-7-6(19)	CH

TABLE 5.—*Engineering*

Soil name and location	Parent material	North Dakota report number	Depth from surface	Moisture-density [1]	
				Maximum dry density	Optimum moisture
			In.	*Lb. per cu. ft.*	*Pct.*
Rhame fine sandy loam:					
900 feet W. of NE. corner of sec. 8, T. 132 N., R. 106 W. (Modal)	Sandstone.	108	10–19	110. 0	15. 0
		109	19–27	107. 2	15. 1
		110	27–41	103. 5	16. 5
Telfer loamy fine sand:					
425 feet W. and 200 feet N. of E. quarter corner of sec. 34, T. 130 N., R. 99 W. (Unlike modal, calcareous substratum)	Sandstone.	87	5–10	111. 0	14. 0
		88	26–36	107. 2	13. 4
Verbar fine sandy loam:					
150 feet E. and 745 feet N. of SW. corner of sec. 27, T. 130 N., R. 99 W. (Modal)	Sandstone.	72	6–11	111. 5	13. 5
		73	17–22	112. 7	14. 3
		74	22–40	112. 7	13. 2
300 feet E. and 50 feet S. of W. quarter corner of sec. 28, T. 130 N., R. 99 W. (Unlike modal calcareous to the surface)	Sandstone.	66	0–16	109. 5	15. 0
		67	16–21	116. 0	14. 0
		68	21–30	112. 6	14. 2
Zeona loamy fine sand:					
110 feet E. and 926 feet S. of NE. corner of sec. 25, T. 129 N., R. 106 W. (Modal)	Eolian sands.	80	6–16	108. 4	12. 9
		81	24–35	109. 2	14. 5
55 feet N. and 150 feet E. of SW. corner sec. 4, T. 132 N., R. 106 W. (Finer textured substratum than modal)	Eolian sands.	114	4–15	112. 2	14. 2
		115	37–47	109. 0	15. 4

[1] Based on AASHO Designation T 99–57, Method A (*1*).

[2] Mechanical analyses according to AASHO Designation T 88–57 (*1*). Results by this procedure may differ somewhat from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material up to and including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method, and the material

TABLE 6.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils for referring to other series that appear in the first column of this table. The sign > means more than;

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal water table		Dominant USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
Absher	3½–6	>6	0–24	Silty clay loam and silty clay.	CL or CH	A–6 or A–7
Mapped only in a complex with Rhoades soils.			24–40	Silty clay, clay, silty clay loam, and loam.	CL or CH	A–6 or A–7
			40–60	Soft shale and siltstone.	----------	----------
Alluvial land:						
Ad	>10	[2] 0–5				
Ae	>10	[2] 0–4				
Af	>10	[2] 0–1				
Properties too variable to estimate. Onsite investigation needed.						

See footnotes at end of table.

test data—Continued

Mechanical analysis [2]								Liquid limit	Plasticity index	Classification	
Percentage passing sieve— [3]				Percentage smaller than—							
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	(0.05 mm.)	(0.02 mm.)	(0.005 mm.)	(0.002 mm.)			AASHO	Unified
								Pct.			
100	100	99	46	37	22	16	11	(4)	(4)	A-4(2)	SM
100	100	99	50	41	28	19	14	(4)	(4)	A-4(2)	SM
100	100	99	42	33	21	16	12	(4)	(4)	A-4(1)	SM
100	100	99	23	19	14	10	8	(4)	(4)	A-2-4(0)	SM
100	100	100	16	14	10	7	5	(4)	(4)	A-2-4(0)	SM
99	99	96	36	33	26	18	15	(4)	(4)	A-4(0)	SM
99	98	95	35	33	28	21	18	(4)	(4)	A-2-4(0)	SM
99	98	97	38	31	22	17	15	(4)	(4)	A-4(1)	SM
100	100	100	38	30	20	14	11	(4)	(4)	A-4(1)	SM
100	100	100	30	23	15	12	9	(4)	(4)	A-2-4(0)	SM
100	100	100	22	17	9	7	5	(4)	(4)	A-2-4(0)	SM
100	100	100	22	17	11	9	7	(4)	(4)	A-2-4(0)	SM
100	100	100	19	15	10	8	6	(4)	(4)	A-2-4(0)	SM
100	100	100	29	22	14	10	8	(4)	(4)	A-2-4(0)	SM
100	100	100	44	32	19	13	11	(4)	(4)	A-4(2)	SM

coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses data used in this table are not suitable for naming textural classes of soils.

[3] 100 percent passed the ¾-inch sieve.

[4] Nonplastic.

significant to engineering

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions
the sign < means less than. Absence of an entry indicates that no determination was made]

Percentage less than 3 inches passing sieve [1]—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						Uncoated steel	Concrete
				In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*			
100	100	95–100	80–95	<0.06	0.10–0.12	7.9–8.4	Moderate to high.	Moderate to high.	High	High.
100	100	95–100	75–95	<0.06	0.07–0.09	8.5–9.0	High	Moderate to high.	High	High.
				0.06–0.20	0.05–0.07	8.5–9.0	Moderate	Moderate to high.	High	High.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal water table		Dominant USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
*Amor: Ag, AlD, AmA, AmB For Cabba part of AlD, see Cabba series; for Shambo part of AmA and AmB, see Shambo series.	1⅔–3⅓	>6	0–13	Loam	ML or CL	A–4 or A–6
			13–31	Loam, and very fine sandy loam.	ML or CL	A–4 or A–6
			31–60	Soft, fine-grained sandstone.		
Arnegard: ArA, ArB	>5	>6	0–13	Loam	ML	A–4
			13–23	Loam	ML or CL	A–4 or A–6
			23–60	Loam	ML or CL	A–4 or A–6
Badland: Ba Properties too variable to estimate. Onsite investigation needed.	0–1⅔	>10				
Barren badland: Bb Properties too variable to estimate. Onsite investigation needed.	0–1	>10				
Belfield: BeA, BeB, BfA, BfB	>3½	>6	0–12	Silty loam and silty clay loam.	ML or CL	A–4 or A–7
			12–31	Silty clay loam and silty clay.	CL or CH	A–6 or A–7
			31–60	Clay loam and loam.	CL	A–6 or A–7
*Blown-out land: Bh Bk Properties too variable to estimate. Onsite investigation needed. For Ekalaka and Ladner parts of Bk, see Ekalaka and Ladner series.	0–5 0–5	>10 >10				
*Boxwell: BoC, BrD, BtB For Cabbart part of BrD, see Cabbart series; for Kremlin part of BtB, see Kremlin series.	1⅔–3⅓	>6	0–11	Loam	ML	A–4
			11–19	Loam	ML	A–4
			19–34	Loam	ML or CL	A–4 or A–6
			34–60	Soft fine-grained sandstone and shale.		
*Brandenburg: BuD For Cabba part of BuD, see Cabba series.	<1½	>10	0–4	Gravelly loam	ML or SM	A–2 or A–4
			4–10	Very channery loam	GM or SM	A–1 or A–2
			10–60	Porcellanite beds.		
*Cabba: CaC, CaE, CbC, CbD, Cd, Ce For Amor part of CbC and CbD, see Amor series; for Wayden part of Cd and Ce, see Wayden series.	<1½	>10	0–17	Silt loam and loam	ML or CL	A–4 or A–6
			17–60	Soft siltstone and fine-grained sandstone.		
*Cabbart: CgC, CgD, ChE, Ck For Boxwell part of CgC and CgD, see Boxwell series; for Yawdim part of Ck, see Yawdim series.	<1½	>10	0–14	Silt loam and loam	ML or CL	A–4 or A–6
			14–60	Soft siltstone or fine-grained sandstone.		
*Chama: CmA, CmB, CnC For Morton part of CmA, CmB, and CnC, see Morton series; for Cabba part of CnC, see Cabba series.	1⅔–3⅓	>8	0–34	Silty clay loam	CL or CH	A–7
			34–60	Soft siltstone or silty shale.		

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches passing sieve [1]—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						Uncoated steel	Concrete
				In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*			
100	100	90–100	60–75	0. 63–2. 0	0. 16–0. 18	6. 6–7. 3	None	Low to moderate.	Moderate	Low.
100	100	90–100	50–75	0. 63–2. 0	0. 15–0. 17	7. 4–8. 4	None	Low to moderate.	Moderate	Low.
				0. 20–0. 63	0. 10–0. 12	7. 9–8. 4		Low	Moderate	Moderate.
100	95–100	90–100	60–75	2. 0–6. 3	0. 19–0. 21	6. 6–7. 3	None	Low	Moderate	Low.
100	95–100	90–100	60–75	0. 63–2. 0	0. 15–0. 17	6. 6–7. 3	None	Low to moderate.	Moderate	Low.
100	95–100	80–100	60–75	0. 63–2. 0	0. 14–0. 16	7. 9–8. 4	None	Low to moderate.	Moderate	Low.
100	100	95–100	70–90	0. 63–2. 0	0. 18–0. 20	6. 1–6. 5	None	Low to moderate.	Moderate	Low.
100	100	95–100	85–95	0. 2–0. 63	0. 17–0. 19	6. 6–7. 8	None	Moderate to high.	High	Moderate.
100	100	95–100	70–80	0. 2–0. 63	0. 09–0. 11	7. 9–8. 4	Moderate	Moderate	High	High.
100	100	95–100	55–70	2. 0–6. 3	0. 16–0. 18	6. 6–7. 3	None	Low	Moderate	Low.
100	100	95–100	55–70	0. 63–2. 0	0. 16–0. 18	7. 4–7. 8	None	Low	Moderate	Low.
100	100	90–100	55–75	0. 63–2. 0	0. 15–0. 17	7. 9–8. 4	None	Low to moderate.	Moderate	Moderate.
				0. 2–0. 63	0. 10–0. 12	7. 9–8. 4		Low	Moderate	Low.
85–95	40–80	35–75	25–65	0. 63–2. 0	0. 12–0. 16	7. 4–7. 8	None	Low	Moderate	Low.
25–70	20–65	15–50	10–30	6. 3–20. 0	0. 02–0. 08	7. 9–8. 4	None	Low	Moderate	Low.
100	100	95–100	65–90	0. 63–2. 0	0. 16–0. 18	7. 4–8. 4	None	Low to moderate.	High	Low.
				0. 06–0. 2	0. 05–0. 07	7. 9–9. 0	None	Low to moderate.	High	Moderate.
100	100	95–100	65–90	0. 63–2. 0	0. 16–0. 18	7. 4–8. 4	None	Low to moderate.	High	Low.
				0. 06–0. 2	0. 05–0. 07	7. 4–8. 4	None	Low to moderate.	High	Moderate.
100	100	95–100	85–95	0. 63–2. 0	0. 16–0. 18	6. 6–7. 8	None	Moderate	Moderate	Low.
				0. 06–0. 2	0. 08–0. 10	7. 9–8. 4	None	Low to moderate.	High	Moderate.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal water table		Dominant USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
Chanta: CoA, CoB	>5	>10	0–22	Loam	ML	A–4
			22–26	Sandy loam or gravelly loam.	ML or SM	A–2 or A–4
			26–60	Gravel and sand	SM or GM	A–1 or A–2
Cherry: CrA, CrB, CrC	>3½	>8	0–7	Clay loam	CL	A–6 or A–7
			7–40	Silty clay loam	CL	A–7
			40–60	Silty loam	ML	A–4
*Daglum: DaB, DdA	>3	>6	0–10	Silt loam, loam, or fine sandy loam.	ML or SM	A–4
For Rhoades part of DdA, see Rhoades series.			10–24	Silty clay or silty clay loam.	CL or CH	A–7
			24–60	Clay loam or silty clay.	CL or CH	A–7 or A–6
Desart	>3½	>6	0–29	Fine sandy loam and loamy fine sand.	SM or ML	A–4
Mapped only with Ekalaka soils.			29–50	Fine sandy loam or loamy fine sand.	SM or ML	A–4
			50–60	Sandstone		
*Dilts: DIC, DIE	<1½	>10	0–19	Clay	CH or MH	A–7
For Lisam part of DIC and DIE, see Lisam series.			19–60	Shale (platy and cretaceous).		
*Ekalaka: EdB, EIC, EmB	>3½	6	0–12	Fine sandy loam or loamy fine sand.	SM	A–2 or A–4
For Desart part of EdB, see Desart series; for Ladner part of EIC and EmB, see Ladner series; for Zeona part of EmB, see Zeona series.			12–21	Fine sandy loam	SM	A–4
			21–60	Fine sandy loam or loamy fine sand.	SM	A–2 or A–4
*Flasher: FeE, FhD, Fm	<1½	>10	0–19	Loamy fine sand or fine sandy loam.	SM	A–2 or A–4
For Vebar part of FhD and Fm, see Vebar series.			19–60	Soft fine-grained sandstone.		
*Fleak: FnD, FoE, FtE	<1½	>10	0–17	Loamy fine sand or fine sandy loam.	SM	A–2 or A–4
For Rhame part of FnD, see Rhame series; for Tusler part of FtE, see Tusler series.			17–60	Soft fine-grained sandstone.		
Glendive: GdA, GdB	>6	[2] >5	0–60	Fine sandy loam	SM	A–4
*Grail: GeA, GeB, GlA, GlB, GoA, GoB	>5	>5	0–7	Silt loam or silty clay loam.	CL or ML	A–4, A–6 or A–7
For Rhoades part of GoA and GoB, see Rhoades series.			7–60	Silty clay or silty clay loam.	CL or CH	A–7
Gm	>5	>½	0–7	Silty clay loam	CL or CH	A–7
Gravel pit: Gp	>5	>5	7–60	Silty clay loam	CL or CH	A–7
Properties too variable to estimate. Onsite investigation needed.						
Hanly: Ha, Hc	>6	[2] >5	0–60	Loamy fine sand, fine sandy loam, and fine sand.	SM	A–2 or A–4
Havre: He, Hm	>6	[2] >5	0–7	Loam or clay loam	ML or CL	A–4 or A–6
			7–60	Loam, fine sandy loam, and very fine sandy loam.	ML	A–4

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches passing sieve [1]—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						Uncoated steel	Concrete
				In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*			
95–100	95–100	80–90	60–75	0. 63–2. 0	0. 14–0. 16	6. 6–7. 3	None	Low	Moderate	Low.
85–95	40–80	35–75	30–60	0. 63–2. 0	0. 13–0. 15	7. 4–7. 8	None	Low	Moderate	Low.
60–80	40–65	20–45	5–25	6. 3–>20. 0	0. 04–0. 06	7. 9–8. 4	None	Low	Moderate	Low.
100	100	90–100	70–80	0. 63–2. 0	0. 16–0. 18	7. 4–7. 8	None	Moderate	High	Low.
100	100	95–100	80–95	0. 63–2. 0	0. 14–0. 16	7. 9–8. 4	None	Moderate	High	Moderate.
100	100	90–100	70–90	0. 63–2. 0	0. 16–0. 18	7. 9–8. 4	None	Low	High	Moderate.
100	100	80–100	45–85	0. 63–2. 0	0. 16–0. 18	6. 1–6. 5	Low	Low	Moderate	Low.
100	100	95–100	80–95	0. 06–0. 2	0. 12–0. 16	7. 4–8. 4	High	High	High	High.
100	100	90–100	70–95	0. 06–0. 2	0. 08–0. 10	7. 9–9. 0	High	High	High	High.
100	100	70–85	40–55	2. 0–6. 3	0. 12–0. 14	5. 6–7. 3	Low	Low	Moderate	Low.
100	100	70–85	40–65	0. 06–0. 2	0. 08–0. 10	7. 9–9. 0	Moderate	Low	High	High.
				0. 06–0. 2	0. 03–0. 05	7. 9–8. 4	Moderate	Low	High	High.
100	95–100	90–100	90–100	0. 06–0. 2	0. 12–0. 14	5. 1–6. 0	Low	High	High	Moderate.
				<0. 06	0. 03–0. 05	4. 5–5. 0	Low	High	High	Moderate.
100	100	60–85	25–50	2. 0–6. 3	0. 10–0. 13	6. 6–8. 4	Low	Low	Moderate	Low.
100	100	70–85	35–50	0. 06–0. 2	0. 06–0. 09	8. 5–9. 0	High	Low	High	High.
100	100	60–85	30–50	0. 06–0. 2	0. 08–0. 11	8. 5–9. 0	High	Low	High	High.
100	95–100	60–85	25–45	2. 0–20. 0	0. 10–0. 12	6. 6–8. 4	None	Low	Moderate	Low.
				0. 2–0. 63	0. 03–0. 04	7. 9–8. 4	None	Low	Moderate	Low.
100	95–100	60–85	25–45	6. 3–20. 0	0. 10–0. 12	6. 6–8. 4	None	Low	Moderate	Low.
				0. 2–0. 63	0. 03–0. 05	7. 9–8. 4	None	Low	Moderate	Low.
100	95–100	70–85	35–50	2. 0–6. 3	0. 11–0. 13	7. 4–8. 4	None	Low	Moderate	Moderate.
100	100	95–100	75–95	0. 63–2. 0	0. 18–0. 20	6. 6–7. 3	None	Moderate	Moderate	Low.
100	100	95–100	85–95	0. 2–0. 63	0. 16–0. 18	6. 6–8. 4	None	High	High	Moderate.
100	100	90–100	75–95	0. 2–0. 63	0. 13–0. 15	7. 4–7. 8	Moderate	High	High	High.
100	100	95–100	85–95	0. 2–0. 63	0. 13–0. 15	7. 4–8. 4	Moderate	High	High	High.
100	100	50–80	15–50	6. 3–20. 0	0. 05–0. 10	7. 4–8. 4	None	Low	Moderate	Low.
100	100	85–100	60–80	0. 63–2. 0	0. 17–0. 19	7. 4–7. 8	None	Low	Moderate	Low.
100	100	70–95	50–80	0. 62–2. 0	0. 14–0. 16	7. 4–8. 4	None	Low	Moderate	Low.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal water table		Dominant USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
Heil Mapped only with McKenzie soils.	>5	[2] 0	0–60	Silty clay and clay	CH	A–7
*Korchea: Kc, Kh, Km, Kn, Ko For Havre part of Kh and Kn, see Havre series; for Straw part of Km and Ko, see Straw series.	>6	[2] >5	0–60	Loam, silty loam, fine sandy loam and very fine sandy loam.	ML or CL	A–4 or A–6
Ke	>6	[2] >1	0–7	Clay loam	CL	A–6 or A–7
			7–60	Clay, silty clay loam, loam, fine sandy loam.	ML or CL	A–4, A–6, or A–7
*Kremlin: KrA, KrB, KsA For Belfield part of KsA, see Belfield series; for Rhoades part of KsA, see Rhoades series.	>3½	>5	0–13	Loam, silt loam, and clay loam.	ML or CL	A–4, A–6, or A–7
			13–60	Loam and fine sandy loam.	ML	A–4
Ladner Mapped only with Blown-out land and Ekalaka soils.	>3½	>5	0–6	Fine sandy loam or loamy fine sand.	SM	A–2 or A–4
			6–24	Fine sandy loam	SM	A–4
			24–60	Fine sandy loam or loamy fine sand.	SM	A–2 or A–4
*Lawther: La, Lc For Rhoades part of Lc, see Rhoades series.	>5	>6	0–6	Silty clay	CL or CH	A–7
			6–60	Silty clay or clay	CL or CH	A–7
*Lefor: LeB, LeC For Vebar part of LeB and LeC, see Vebar series.	1⅔–3⅓	>6	0–5	Fine sandy loam	SM	A–4
			5–20	Sandy clay loam and loam.	SC or CL	A–6
			20–33	Fine sandy loam	SM	A–4
			33–60	Soft sandstone	----------	----------
*Lehr: LmC For Manning and Wabek parts, see Manning and Wabek series.	>5	>10	0–18	Loam and gravelly loam.	ML or ML–CL	A–4
			18–60	Gravel and sand	SM or GM	A–2
Lisam Mapped only with Dilts soils.	<1½	>10	0–15	Clay	CH or MH	A–7
			15–60	Soft shale	----------	----------
Manning: MaA, MaB	>5	>10	0–25	Fine sandy loam	SM or ML	A–4
			25–37	Gravelly fine sand	SM	A–2 or A–4
			37–60	Gravelly sand	SM or GM	A–1 or A–2
*Marmarth: MeB, MgC, MhB, MhC, MkA, MkB, MkC, Mm. For Cabbart part of MgC, see Cabbart series; for Rhame part of MhB and MhC, see Rhame series; for Rhoades part of MkA, MkB, and MkC, see Rhoades series.	1⅔–3⅓	>6	0–7	Loam, silt loam and fine sandy loam.	ML	A–4
			7–25	Clay loam and loam	CL	A–6
			25–35	Loam	ML or CL	A–4, A–6, or A–7
			35–60	Soft argillaceous sandstone.	----------	----------
*McKenzie: Mn, Mo For Heil part of Mo, see Heil series.	>5	[2] 0	0–34	Silty clay and clay	CH	A–7
			34–60	Sandy clay, clay, and clay loam.	CL or CH	A–6 or A–7
Mine dumps: Mp Properties too variable to estimate. Onsite investigation needed.	>5	>10				

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches passing sieve [1]—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						Uncoated steel	Concrete
				In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*			
100	100	100	80–95	<0. 06	0. 12–0. 14	6. 6–9. 0	Moderate	High	High	High.
100	100	70–95	50–85	0. 63–2. 0	0. 17–0. 19	7. 9–8. 4	None	Low to moderate.	Moderate	Low.
100	100	90–100	70–80	0. 63–2. 0	0. 17–0. 19	7. 4–7. 8	Low	Moderate	High	Moderate.
100	100	75–100	50–90	0. 63–2. 0	0. 17–0. 19	7. 4–8. 4	Low	Moderate	High	Moderate.
100	100	90–100	60–85	0. 63–2. 0	0. 18–0. 20	6. 1–7. 3	None	Low to moderate.	Moderate	Low.
100	100	75–95	50–75	0. 63–2. 0	0. 17–0. 19	6. 6–7. 8	None	Low to moderate.	Moderate	Moderate.
100	100	60–80	25–50	2. 0–6. 3	0. 10–0. 12	6. 6–7. 3	Low	Low	High	Moderate.
100	100	70–85	35–50	0. 06–0. 2	0. 07–0. 09	8. 5–9. 0	High	Low	High	High.
100	100	60–80	25–50	0. 06–0. 63	0. 08–0. 10	8. 5–9. 0	High	Low	High	High.
100	100	95–100	85–95	0. 2–0. 63	0. 16–0. 18	7. 9–8. 4	None	High	Moderate	Moderate.
100	100	95–100	85–95	0. 06–0. 2	0. 14–0. 16	7. 9–8. 4	Low to moderate.	High	High	High.
100	100	70–85	35–45	2. 0–6. 3	0. 14–0. 16	6. 1–6. 5	None	Low	Moderate	Low.
100	100	80–95	35–70	0. 63–2. 0	0. 14–0. 16	6. 6–7. 3	None	Low	Moderate	Low.
100	100	70–85	40–50	2. 0–6. 3	0. 12–0. 14	7. 4–7. 8	None	Low	Moderate	Moderate.
				0. 2–0. 63	0. 03–0. 04	7. 9–8. 4	None	Low	Moderate	Moderate.
90–100	85–95	80–90	50–70	2. 0–6. 3	0. 14–0. 16	6. 6–8. 4	None	Low	Moderate	Low.
45–70	40–65	20–40	5–20	>20. 0	0. 04–0. 06	7. 9–8. 4	None	Low	Moderate	Low.
100	95–100	90–100	75–95	0. 06–0. 2	0. 16–0. 19	7. 9–8. 4	Low	High	Moderate	Moderate.
				<0. 06	0. 03–0. 05	7. 9–8. 4	Low to moderate.	High	High	High.
95–100	85–95	70–85	40–60	2. 0–6. 3	0. 14–0. 16	6. 6–8. 4	None	Low	Moderate	Low.
85–95	80–90	40–60	30–45	6. 3–20. 0	0. 08–0. 10	7. 9–8. 4	None	Low	Moderate	Low.
50–80	40–65	40–60	5–20	>20. 0	0. 02–0. 04	7. 9–8. 4	None	Low	Moderate	Low.
100	100	85–95	50–80	0. 63–2. 0	0. 18–0. 20	6. 6–7. 3	None	Low	Moderate	Low.
100	100	90–100	65–80	0. 63–2. 0	0. 17–0. 19	6. 8–8. 4	None	Moderate	Moderate	Moderate.
100	100	85–95	60–75	0. 63–2. 0	0. 16–0. 18	7. 9–8. 4	None	Moderate	Moderate	Moderate.
				0. 2–0. 63	0. 08–0. 10	7. 9–8. 4	Low	Moderate	Moderate	Moderate.
100	100	100	80–95	<0. 06	0. 12–0. 14	8. 5–9. 0	Low to moderate.	High	High	High.
100	100	80–95	50–90	0. 06–0. 2	0. 12–0. 14	8. 5–9. 0	Low to moderate.	High	High	High.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal water table		Dominant USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
*Moreau: MrA, MrB, MwC For Wayden part of MwC, see Wayden series.	2–2⅔ 1⅔–3⅔	>6	0–11 11–22	Silty clay Silty clay	CH CH	A–7 A–7
			22–60	Soft shale and siltstone.		
Morton Mapped only with Chama soils.	1⅔–3⅓	>6	0–7 7–29 29–35 35–60	Silty clay loam Silty clay loam Silt loam Soft silty shale	CL CL ML or CL	A–7 A–7 A–4 or A–6
Oburn: Ob	>5	>10	0–7 7–15 15–36	Silt loam Clay Clay loam and silty clay.	ML CH or CL CL	A–4 A–7 A–6 or A–7
			36–60	Gravel	SM or GM	A–2
Parshall: PaA	>5	>6	0–30 30–60	Fine sandy loam Loamy fine sand	SM SM	A–2 or A–4 A–2
Patent: PeB, PeC	>3½	>6	0–60	Loam and silt loam	ML or CL	A–4 or A–6
*Reeder: RcC, RdA, RdB, RdC, ReA, ReB, Rf. For Cabba part of RcC, see Cabba series; for Rhoades part of RdA, RdB and RdC, see Rhoades series.	1⅔–3⅓	>6	0–8 8–36 36–60	Loam and silt loan Clay loam or loam Soft, fine-grained sandstone and siltstone.	ML or CL CL	A–4 or A–6 A–6
Regan: Rg	>5	1–4	0–35 35–60	Silty clay loam or silt loam. Clay loam and silty clay.	ML or CL CL	A–4 or A–6 or A–7. A–6 or A–7
*Regent: RhA, RhB, RkC, RlB, RmA For Moreau part of RkC and RlB, see Moreau series; for Rhoades part of RlB and RmA, see Rhoades series.	1⅔–3⅓	>6	0–7 7–18 18–37 37–60	Silty clay loam and and silty clay. Silty clay Silty clay loam or silty clay. Soft shale	CL or CH CL or CH CL or CH	A–7 A–7 A–7
*Rhame: RnB, RoC, RoD For Fleak part of RoC and RoD, see Fleak series.	1⅔–3⅓	>8	0–34 34–60	Fine sandy loam Soft sandstone	SM	A–4
*Rhoades: RrA, RrB, Rt For Absher part of RrA and RrB, see Absher series.	>2	>6	0–5 5–35 35–60	Loam, silt loam, and silty clay loam. Silty clay or silty clay loam. Soft shale	ML, CL or CH CL or CH	A–4, A–6, or A–7 A–7
Riverwash: Rw Properties too variable to estimate. Onsite investigation needed.	>10	0–5				
*Savage: SaA, ScA For Rhoades part of ScA, see Rhoades series.	>3½	>6	0–6 6–60	Silty clay loam Silty clay or silty clay loam.	CL CL or CH	A–7 A–7
Searing: SeB, SeC	1⅔–3⅓	>10	0–28 28–60	Loam Porcellanite (scoria).	ML or CL	A–4 or A–6

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches passing sieve [1]—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						Uncoated steel	Concrete
				In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*			
100	100	95–100	85–95	0. 2–0. 63	0. 17–0. 19	7. 9–8. 4	Low	High	High	Moderate
100	100	95–100	85–95	0. 06–0. 2	0. 17–0. 19	7. 9–8. 4	Moderate to high.	High	High	Moderate
				<0. 06	0. 04–0. 08	7. 9–8. 4	High	High	High	High.
100	100	95–100	80–95	0. 63–2. 0	0. 18–0. 20	6. 6–7. 3	None	Moderate	Moderate	Low.
100	100	95–100	80–95	0. 63–2. 0	0. 18–0. 20	6. 6–8. 4	None	Moderate	Moderate	Moderate.
100	100	95–100	70–90	0. 63–2. 0	0. 18–0. 20	7. 9–8. 4	None	Moderate	Moderate	Moderate.
				0. 06–0. 2	0. 04–0. 08	7. 9–8. 4	Low	Moderate	Moderate	Moderate.
100	100	85–95	70–85	0. 63–2. 0	0. 14–0. 16	6. 1–6. 5	Low	Moderate	High	Moderate.
100	100	95–100	85–95	0. 06–0. 2	0. 08–0. 10	6. 6–8. 4	High	High	High	High.
100	95–100	95–100	75–95	0. 06–0. 2	0. 08–0. 10	7. 9–8. 4	High	High	High	High.
50–80	40–65	25–40	5–20	6. 3–>20. 0	0. 04–0. 06	7. 9–8. 4	Moderate	Low	High	Moderate.
100	95–100	70–85	25–50	2. 0–6. 3	0. 13–0. 15	6. 6–7. 3	None	Low	Moderate	Low.
100	100	50–75	15–35	6. 3–20. 0	0. 09–0. 11	7. 4–8. 4	None	Low	Moderate	Low.
100	95–100	85–95	60–85	0. 63–2. 0	0. 14–0. 16	7. 4–8. 4	None to low.	Low to moderate.	Moderate	Moderate.
100	100	85–95	60–90	0. 63–2. 0	0. 17–0. 19	6. 6–7. 3	None	Low	Moderate	Low.
100	100	90–100	65–80	0. 63–2. 0	0. 16–0. 18	6. 6–8. 4	None	Moderate	Moderate	Low.
				0. 2–0. 63	0. 08–0. 10	7. 9–8. 4	Low	Moderate	Moderate	Moderate.
100	100	95–100	75–95	0. 63–2. 0	0. 14–0. 16	7. 9–8. 4	Moderate	Moderate	High	Moderate to high.
80–100	75–95	70–90	65–85	0. 63–2. 0	0. 11–0. 13	7. 9–8. 4	Moderate	Moderate	High	High.
100	100	95–100	85–95	0. 63–2. 0	0. 18–0. 20	6. 6–7. 3	None	Moderate	Moderate	Low.
100	100	95–100	90–95	0. 2–0. 63	0. 17–0. 19	7. 4–7. 8	None	Moderate to high.	Moderate	Moderate.
100	100	95–100	85–95	0. 06–0. 2	0. 17–0. 19	7. 9–8. 4	Low	Moderate to high.	High	Moderate.
				<0. 2	0. 04–0. 08	7. 9–8. 4	Low	Moderate to high.	High	Moderate.
100	100	70–85	35–50	2. 0–6. 3	0. 12–0. 14	6. 6–8. 4	None	Low	Moderate	Low.
				0. 2–0. 63	0. 06–0. 08	7. 4–8. 4	None	Low	Moderate	Moderate.
100	100	85–100	85–95	0. 63–2. 0	0. 16–0. 18	6. 1–6. 5	Low	Moderate	Moderate	Low.
100	100	95–100	70–95	<0. 06	0. 09–0. 12	7. 9–9. 0	Moderate to high.	High	High	Moderate to high.
				<0. 2	0. 06–0. 08	8. 5–9. 0	High	High	High	High.
100	100	95–100	85–95	0. 63–2. 0	0. 18–0. 20	6. 6–7. 3	None	Moderate	Moderate	Low.
100	100	95–100	85–95	0. 2–0. 63	0. 15–0. 17	7. 4–8. 4	None to low.	High	Moderate	Moderate.
95–100	95–100	85–95	55–75	0. 63–2. 0	0. 18–0. 20	6. 6–8. 4	None	Low to moderate.	Moderate	Low.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal water table		Dominant USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
Sham: Sg	>3½	>6	0–60	Loam, fine sandy loam, very fine sandy loam, and silt loam.	ML or SM	A–4
*Shambo: ShA, ShB, SlA, SlB, SmA For Arnegard part of SlA and SlB, see Arnegard series; for Belfield and Rhoades parts of SmA, see Belfield and Rhoades series.	>3½	>6	0–46 46–60	Loam Gravelly sandy loam	ML or CL SM or GM	A–4 or A–6 A–1 or A–2
*Stady: SnA, SrB, SsA For Lehr part of SrB, see Lehr series; for Shambo part of SsA, see Shambo series.	>5	>6	0–27 27–60	Loam and gravelly loam. Sand and gravel	ML SM or GM	A–4 A–2
Straw Mapped only with Korchea soils.	>6	>5	0–60	Loam or silt loam	ML or CL	A–4 or A–6
*Tally: TaB, TaC, TdA For Parshall part of TdA, see Parshall series.	>3½	>6	0–60	Fine sandy loam and sandy loam.	SM	A–2 or A–4
*Telfer: Te, TfC For Flasher part of TfC, see Flasher series.	>3½	>6	0–54 54–60	Loamy fine sand Soft sandstone	SM	A–2
Toby: ToA, ToB, ToC, TrA	>3½	>5	0–8 8–60	Fine sandy loam and loam. Fine sandy loam	ML or SM SM	A–4 A–2 or A–4
Tusler Mapped only with Fleak and Zeona soils.	1⅔–3⅓	>10	0–27 27–60	Loamy fine sand Soft sandstone	SM	A–2
*Vebar: VfC, VfD, VtB For Flasher part of VfC and VfD, see Flasher series; for Tally part of VtB, see Tally series.	1⅔–3⅓	>8	0–34 34–60	Fine sandy loam and loamy fine sand. Soft, fine-grained sandstone.	SM	A–2 or A–4
Velva: Vv	>6	[2] >5	0–60	Fine sandy loam, sandy loam, loam, and gravelly sandy loam.	ML or SM	A–2 or A–4
Wabek: Wa	>4	>10	0–8 8–60	Loam and gravelly loam. Gravel and sand	SM SM or GM	A–2 A–1 or A–2
Watrous: Wm	1⅔–3⅓	>10	0–22 22–60	Clay loam and loam Hard sandstone.	ML or CL	A–4, A–6, or A–7
*Wayden: WoC For Moreau part, see Moreau series.	<1½	>10	0–15 15–60	Silty clay and silty clay loam. Soft shale	CL or CH	A–7
Wolf Point: Wp	>5	[2] >5	0–60	Clay or silty clay	CH	A–7

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches passing sieve [1]—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						Uncoated steel	Concrete
				In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*			
100	100	80–100	35–75	0. 06–0. 2	0. 12–0. 14	7. 9–9. 0	Moderate	Moderate	High	Moderate to high.
100	100	85–95	65–80	0. 63–2. 0	0. 15–0. 17	6. 6–8. 4	None	Low to moderate.	Moderate	Low.
30–70	25–60	15–50	10–30	6. 3–20. 0	0. 02–0. 08	7. 9–8. 4	None	Low	Moderate	Low.
80–100	75–95	70–85	55–70	0. 63–2. 0	0. 14–0. 16	6. 6–8. 4	None	Low	Moderate	Low.
60–80	40–65	20–40	5–25	>20. 0	0. 04–0. 06	7. 9–8. 4	None	Low	Moderate	Low.
100	100	90–100	60–85	0. 63–2. 0	0. 18–0. 20	6. 6–8. 4	None	Low to moderate.	Moderate	Low.
100	100	60–85	30–50	2. 0–6. 3	0. 13–0. 15	6. 6–8. 4	None	Low	Moderate	Low.
100	100	50–85	15–35	6. 3–20. 0	0. 09–0. 11	6. 6–7. 8	None	Low	Moderate	Low.
				0. 2–0. 63	0. 06–0. 09	7. 9–8. 4	None	Low	Moderate	Low.
100	100	70–95	40–65	2. 0–6. 3	0. 16–0. 18	6. 6–7. 3	None	Low	Moderate	Low.
100	100	70–85	30–50	2. 0–6. 3	0. 13–0. 15	6. 6–8. 4	None	Low	Moderate	Low.
100	95–100	50–85	15–35	6. 3–20. 0	0. 09–0. 11	6. 6–8. 4	None	Low	Moderate	Low.
				0. 2–0. 63	0. 06–0. 08	7. 4–7. 8	None	Low	Moderate	Low.
100	95–100	60–85	25–45	2. 0–6. 3	0. 10–0. 14	6. 1–8. 4	None	Low	Moderate	Low.
				0. 2–0. 63	0. 06–0. 08	7. 9–8. 4	Low	Low	Moderate	Moderate.
90–100	85–100	65–90	30–55	0. 63–2. 0	0. 12–0. 14	7. 4–7. 8	None to low.	Low	Moderate	Low.
95–100	80–95	60–75	15–35	2. 0–6. 3	0. 11–0. 13	7. 4–7. 8	None	Low	Moderate	Low.
60–90	40–60	20–50	5–20	>20. 0	0. 02–0. 04	7. 4–8. 4	None	Low	Moderate	Low.
100	95–100	85–100	65–90	0. 63–2. 0	0. 18–0. 20	6. 1–7. 8	None	Low to moderate.	Moderate	Low.
100	100	95–100	85–95	0. 06–0. 2	0. 15–0. 17	7. 9–8. 4	Low to high	High	High	Moderate.
				0. 06–0. 2	0. 04–0. 06	7. 9–8. 4	Moderate to high.	High	High	Moderate.
100	100	95–100	85–95	0. 06–0. 2	0. 12–0. 14	6. 6–8. 4	Low to moderate.	High	High	Moderate.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to—		Depth from surface	Classification		
	Bedrock	Seasonal water table		Dominant USDA texture	Unified	AASHO
	Ft.	*Ft.*	*In.*			
Yawdim: YaC	>1½	>10	0–15	Silty clay	CL or CH	A–7
			15–60	Softy platy shale or claystone.		
*Zeona: Zd, ZeC, ZfB, ZtC For Tusler part of ZtC, see Tusler series.	>3½	>10	0–37	Loamy fine sand or fine sand.	SM	A–2
			37–60	Fine sand	SM or SP	A–2 or A–3

[1] The stony and very stony soils in the Amor, Bradenburg, Boxwell, Cabba, Flasher, Marmarth, Reeder, Vebar, and Wayden series have 20 to 50 percent material more than 3 inches in diameter in the upper 12 inches.

TABLE 7.—*Interpretations of*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in such mapping units may have

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill (trench type) [1]	Local roads and streets
Absher Mapped only with Rhoades soils.	Severe: very slow permeability.	Slight	Severe: poor workability; more than 15 percent exchangeable sodium.	Severe: high to moderate shrink-swell potential.	Severe: clayey texture; soft shale and siltstone at depth of 40 to 60 inches.	Severe: moderate to high shrink-swell potential.
Alluvial land: Ad, Ae, Af. Properties too variable to estimate. Onsite investigations needed.						
*Amor: Ag, AlD, AmA, AmB For Cabba part of AlD, see Cabba series; for Shambo part of AmA and AmB, see Shambo series.	Severe: bedrock at depth of 20 to 40 inches.	Moderate where slopes are 3 to 6 percent; moderate permeability. Severe where slopes are more than 6 percent.	Slight where slopes are less than 9 percent. Moderate where slopes are more than 9 percent.	Moderate: low to moderate shrink-swell potential.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate: low to moderate shrink-swell potential.
Arnegard: ArA, ArB	Moderate: moderate permeability.	Moderate: moderate permeability.	Slight	Moderate: low to moderate shrink-swell potential.	Slight	Moderate: low to moderate shrink-swell potential.
Badland: Ba. Properties too variable to estimate. Onsite investigation needed.						
Barren badland: Bb. Properties too variable to estimate. Onsite investigation needed.						
Belfield: BeA, BeB, BfA, BfB	Severe: moderately slow permeability.	Moderate where slopes are 3 to 6 percent. Severe where slopes are more than 6 percent.	Slight	Moderate: moderate shrink-swell potential.	Slight	Severe: moderate to high shrink-swell potential.

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches passing sieve [1]—				Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential	Corrosivity	
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)						Uncoated steel	Concrete
				In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*			
100	100	95–100	85–95	0. 06–0. 63	0. 16–0. 18	7. 9–8. 4	Low to high	High	High	Moderate.
				0. 06–0. 2	0. 04–0. 06	7. 9–8. 4	Moderate to high.	High	High	Moderate.
100	100	50–80	15–35	6. 3–20. 0	0. 06–0. 09	6. 1–7. 3	None	Low	Moderate	Low.
100	100	50–85	2–25	6. 3–20. 0	0. 04–0. 05	7. 4–7. 8	None	Low	Moderate	Low.

[2] Subject to flooding.

engineering properties of the soils

different properties and limitations, and for this reason it is necessary to follow carefully the instructions for referring to other series that appear in the first column of this table]

Suitability as source of—			Soil features affecting—					
Road fill	Sand or gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Poor: moderate to high shrink-potential.	Unsuitable	Poor: limited amount of suitable material over dense claypan.	All features favorable.	Moderate shrink-swell potential; susceptible to sliding.	Not needed	Slow intake rate; very slow permeability.	Unstable embankments; dense claypan.	Vegetation difficult to establish; dense claypan.
Fair: frost-heave potential.	Unsuitable	Good where slopes are 0 to 9 percent. Fair where slopes are 9 to 15 percent. Poor where slopes are more than 15 percent.	Moderate permeability.	Fair compaction and stability.	Not needed	Hazard of water erosion; moderately deep.	Soft bedrock at a depth of 20 to 40 inches.	Steep slopes in places.
Fair: low to moderate shrink-swell potential.	Unsuitable	Good	Moderately rapid permeability in substratum in places.	Hazard of piping; fair to poor stability when compacted.	Not needed	All features favorable.	All features favorable.	All features favorable.
Poor: moderate to high shrink-swell potential.	Unsuitable	Fair: silty clay loam and silt loam to a depth of 12 inches.	All features favorable.	Moderate shrink-swell potential; susceptible to sliding.	Not needed	Slow intake rate; moderately slow permeability.	Unstable embankments.	Vegetation difficult to establish; claypan subsoil.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill (trench type) [1]	Local roads and streets
*Blown-out land: Bh, Bk. Properties too variable to estimate. Onsite investigation needed. For Ekalaka and Ladner parts of BK, see Ekalaka and Ladner series.						
*Boxwell: BoC, BrD, BtB. For Cabbart part of BrD, see Cabbart series; for Kremlin part of BtB, see Kremlin series.	Severe: rippable bedrock at a depth of 20 to 40 inches.	Moderate where slopes are 3 to 6 percent; moderate permeability. Severe where slopes are more than 6.	Moderate: rippable bedrock at depth of 20 to 40 inches.	Moderate: rippable bedrock at depth of 20 to 40 inches.	Moderate: rippable bedrock at depth of 20 to 40 inches.	Slight.
Brandenburg: BJD. For Cabba part of BuD, see Cabba series.	Slight where slopes are 3 to 9 percet. Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.	Severe: rapid permeability.	Slight where slopes are 3 to 9 percent. Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.	Severe: rippable bedrock at depth of less than 20 inches.	Severe: rapid permeability.	Slight where slopes are 3 to 9 percent. Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.
*Cabba: CaC, CaE, CbC, CbD, Cd, Ce. For Amor part of CbC and CbD, see Amor series; for Wayden part of Cd and Ce, see Wayden series.	Severe: rippable bedrock at a depth of less than 20 inches.	Moderate where slopes are less than 6 percent. Severe where slopes are more than 6 percent.	Moderate where slopes ar 6 to 15 percent; rippable bedrock. Severe where slopes are more than 15 percent.	Moderate where slopes are 6 to 15 percent; rippable bedrock. Severe where slopes are more than 15 percent.	Moderate: rippable bedrock at depth of less than 20 inches.	Slight where slopes are 6 to 9 percent. Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.
*Cabbart: CgC, CgD, ChE, Ck. For Boxwell part of CgC and CgD, see Boxwell series; for Yawdim part of Ck, see Yawdim series.	Severe: soft bedrock at a depth of less than 20 inches.	Moderate where slopes are 3 to 6 percent. Severe where slopes are more than 6 percent.	Moderate where slopes are 3 to 15 percent; rippable bedrock. Severe where slopes are more than 15 percent.	Moderate where slopes are 3 to 15 percent; rippable bedrock. Severe where slopes are more than 15 percent.	Moderate: rippable bedrock at a depth of less than 20 inches.	Slight where slopes are less than 9 percent. Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.
*Chama: CmA, CmB, CnC. For Morton part of CmA, CmB, and CnC, see Morton series; for Cabba part of CnC, see Cabba series.	Severe: rippable bedrock at a depth of less than 20 to 40 inches.	Moderate where slopes are 3 to 6 percent. Severe where slopes are more than 6 percent.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate: low to moderate shrink-swell potential.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate: low to moderate shrink-swell potential.
Chanta: CoA, CoB.	Slight [2].	Severe: moderate permeability above substratum, rapid and very rapid permeability in gravelly substratum.	Moderate: gravelly substratum.	Slight.	Severe: very rapid permeability in substratum.	Slight.
Cherry: CrA, CrB, CrC.	Moderate: moderate permeability.	Moderate where slopes are 0 to 6 percent; moderate permeability. Severe where slopes are more than 6 percent.	Slight.	Moderate: moderate shrink-swell potential.	Slight.	Moderate: moderate shrink-swell potential.

See footnotes at end of table.

engineering properties of the soils—Continued

Suitability as source of—			Soil features affecting—					
Road fill	Sand or gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Fair: frost-heave potential.	Unsuitable	Good	Moderate permeability.	Fair compaction and stability.	Not needed	Hazard of water erosion; rippable bedrock at depth of 20 to 40 inches.	Soft bedrock at depth of 20 to 40 inches.	All features favorable.
Poor: shallow to porcellanite beds.	Unsuitable	Poor: 4 inches of material over very channery loam and porcellanite beds.	Rapid permeability; excessive slope.	Poor compaction characteristics.	Not needed	Not suitable	Not needed	Not needed.
Fair where slopes are less than 25 percent; low to moderate shrink-swell potential. Poor where slopes are more than 25 percent.	Unsuitable	Poor: steep slopes; limited amount of suitable material.	Steep slopes	Low to moderate shrink-swell potential.	Not needed	Not suitable	Not needed	Not needed.
Fair where slopes are less than 25 percent; low to moderate shrink-swell potential. Poor where slopes are more than 25 percent.	Unsuitable	Poor: steep slopes; limited amount of material.	Slopes	Low to moderate shrink-swell potential.	Not needed	Not suitable	Not needed	Not needed.
Fair: low to moderate shrink-swell potential.	Unsuitable	Fair: surface layer of silty clay loam.	Slopes	Low to moderate shrink-swell potential.	Not needed	Hazard of water erosion.	Rippable bedrock at a depth of 20 to 40 inches.	Slopes in places.
Good	Poor: fines	Good	Very rapid permeability in substratum.	Moderate permeability above gravelly substratum; hazard of piping.	Not needed	Low available water capacity.	Not needed	Not needed.
Fair: moderate shrink-swell potential.	Unsuitable	Fair: surface layer of clay loam.	Moderate permeability.	Moderate shrink-swell potential.	Not needed	Hazard of water erosion.	Susceptible to siltation.	Slopes in places.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill (trench type) [1]	Local roads and streets
*Daglum: DaB, DdA. For Rhoades part of DdA, see Rhoades series.	Severe: slow permeability.	Slight where slopes are less than 3 percent. Moderate where slopes are 3 to 6 percent.	Severe: poor workability; more than 5 percent exchangeable sodium.	Severe: high shrink-swell potential.	Severe: silty clay loam or silty clay subsoil.	Severe: high shrink-swell potential.
Desart. Mapped only with Ekalaka soils.	Severe: slow permeability.	Severe: in places permeability is moderately rapid in the substratum if material is disturbed.	Severe: workability; more than 15 percent exchangeable sodium.	Slight: rippable bedrock below depth of 50 inches.	Severe: moderately rapid permeability in substratum in places.	Moderate: unstable material.
*Dilts: DIC, DIE. For Lisam part of DIC DIE, see Lisam series.	Severe: slow permeability.	Moderate where slopes are 3 to 6 percent. Severe where slopes are more than 6 percent.	Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.	Severe: high shrink-swell potential.	Severe: clay texture; rippable bedrock at depth of less than 20 inches.	Severe: high shrink-swell potential.
*Ekalaka: EdB, EIC, EmB. For Desart part of EdB, see Desart series; for Ladner part of EIC and EmB, see Ladner series; for Zeona part of EmB, see Zeona series.	Severe: slow permeability.	Severe: in places permeability is moderately rapid in the substratum if material is disturbed.	Severe: workability; more than 15 percent exchangeable sodium.	Slight.	Severe: moderately rapid permeability in substratum in places.	Moderate: unstable material.
*Flasher: FeE, FhD, Fm. For Vebar part of FhD and Fm, see Vebar series.	Severe: soft bedrock at a depth of less than 20 inches.	Severe: slopes of more than 6 percent; rapid and moderately rapid permeability.	Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.	Moderate where slopes are 9 to 15 percent; rippable bedrock at depth of less than 20 inches. Severe where slopes are more than 15 percent.	Moderate: rippable bedrock at a depth of less than 20 inches.	Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.
*Fleak: FhD, FoE, FtE. For Rhame part of FnD, see Rhame series; for Tusler part of FtE, see Tusler series.	Severe: soft bedrock at depth of less than 20 inches.	Severe: slopes of more than 6 percent; rapid permeability.	Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.	Moderate where slopes are 9 to 15 percent; rippable bedrock. Severe where slopes are more than 15 percent.	Moderate :rippable bedrock at a depth of less than 20 inches.	Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.
Glendive: GdA, GdB.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.
*Grail: GeA, GeB, GIA, GIB, GoA, GoB. For Rhoades part of GoA and GoB, see Rhoades series.	Severe: moderately slow permeability.	Slight where slopes are 0 to 3 percent. Moderate where slopes are 3 to 6 percent.	Moderate: poor workability; silty clay texture.	Severe: high shrink-swell potential.	Moderate: silty clay texture.	Severe: high shrink-swell potential.
Gm.	Severe: moderately slow permeability.	Severe: seasonal water table at a depth of less than 40 inches.	Severe: seasonal water table at a depth of less than 40 inches.	Severe: high shrink-swell potential.	Severe: seasonal water table at a depth of less than 40 inches.	Severe: high shrink-swell potential.
Gravel pit: Gp. Properties too variable to estimate. On-site investigation needed.						
Hanly: Ha, Hc.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: rapid permeability; subject to flooding.	Moderate: subject to flooding.

See footnotes at end of table.

engineering properties of the soils—Continued

Suitability as source of—			Soil features affecting—					
Road fill	Sand or gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Poor: high shrink-swell potential.	Unsuitable	Good to a depth of 8 inches. Fair to a depth of 16 inches; silty clay loam subsoil.	All features favorable.	High shrink-swell potential; susceptible to sliding.	Not needed	Slow intake rate; slow permeability.	Unstable embankments; dense clay pan.	Vegetation difficult to establish; dense clay pan.
Fair: unstable material.	Unsuitable	Good	Moderately rapid permeability in substratum in places.	Hazard of piping.	Not needed	Slow permeability in subsoil.	Unstable material for embankments; susceptible to siltation and soil blowing.	Erodible; vegetation difficult to establish.
Poor: high shrink-swell potential.	Unsuitable	Poor: clay texture.	Steep slopes	High shrink-swell potential.	Not needed	Slow permeability.	Not needed	Not needed.
Fair: unstable material.	Unsuitable	Good to a depth of 12 inches. Poor below a depth of 12 inches; high content of sodium.	Moderately rapid permeability in substratum in places.	Hazard of piping.	Not needed	Slow permeability in subsoil.	Unstable material for embankments; susceptible to siltation and soil blowing.	Erodible; vegetation difficult to establish.
Fair where slopes are less than 25 percent; more than 30 percent fines. Poor where slopes are more than 25 percent.	Unsuitable	Good to a depth of 8 inches. Poor below a depth of 8 inches; loamy fine sand.	High seepage	Hazard of piping.	Not needed	Not suitable	Not needed	Not needed.
Fair where slopes are less than 25 percent; more than 30 percent fines. Poor where slopes are more than 25 percent.	Unsuitable	Poor: loamy fine sand texture.	High seepage potential.	Hazard of piping.	Not needed	Not suitable	Not needed	Not needed.
Fair: more than 30 percent fines.	Unsuitable	Good	Moderately rapid permeability.	Hazard of piping.	Not needed	Subject to flooding.	Not needed	Not needed.
Poor: high shrink-swell potential.	Unsuitable	Fair: silty clay texture.	All features favorable.	High shrink-swell potential.	Not needed	Moderately slow permeability.	Moderately slow permeability; silty clay texture.	All features favorable.
Poor: high shrink-swell potential.	Unsuitable	Poor: many soluble salts.	All features favorable.	High shrink-swell potential.	Seasonal water table at a depth of less than 40 inches.	Moderately slow permeability; many soluble salts.	Moderately slow permeability; silty clay texture.	Vegetation difficult to establish.
Fair: more than 30 percent fines.	Poor for sand: fines. Unsuitable for gravel.	Poor: loamy fine sand in places.	Rapid permeability.	Rapid permeability; subject to piping.	Not needed	Low available water capacity; subject to flooding.	Not needed	Not needed.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill (trench type) [1]	Local roads and streets
Havre: He, Hm	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.
Heil Mapped only with McKenzie soils.	Severe: very slow permeability.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: high shrink-swell potential; subject to flooding.	Severe: subject to flooding.	Severe: poorly drained; high shrink-swell potential.
*Korchea: Kc, Kh, Km, Kn, Ko For Havre part of Kh and Kn, see Havre series; for Straw part of Km and Ko, see Straw series.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Ke	Severe: seasonal water table at a depth of less than 48 inches.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
*Kremlin: KrA, KrB, KsA For Belfield and Rhoades parts of KsA, see Belfield and Rhoades series.	Moderate: moderate permeability.	Moderate: moderate permeability.	Slight	Moderate: low to moderate shrink-swell potential.	Slight	Slight
Ladner Mapped only with Blown-out land and Ekalaka soils.	Severe: slow permeability.	Severe: in places permeability is moderately rapid in substratum if the material is disturbed.	Severe: poor workability; more than 15 percent exchangeable sodium.	Slight	Severe: moderately rapid permeability in substratum in places.	Moderate: unstable material.
*Lawther: La, Lc For Rhoades part of Lc, see Rhoades series.	Severe: slow permeability.	Slight	Moderate: clayey texture.	Severe: high shrink-swell potential.	Severe: clayey texture.	Severe: high shrink-swell potential.
*Lefor: LeB, LeC For Vebar part of LeB and LeC, see Vebar series.	Severe: rippable bedrock at a depth of 20 to 40 inches.	Moderate: moderate to moderately rapid permeability.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Slight
*Lehr: LmC For Manning and Wabek parts, see Manning and Wabek series.	Slight [2]	Severe: moderately rapid permeability above gravel, very rapid permeability in gravel.	Severe: gravelly substratum.	Slight	Severe: moderately rapid permeability above gravel, very rapid permeability in gravel.	Slight
Lisam Mapped only with Dilts soils.	Severe: slow permeability.	Moderate where slopes are 0 to 6 percent. Severe where slopes are more than 6 percent.	Severe: poor workability; clay texture; rippable bedrock at a depth of less than 15 inches.	Severe: high shrink-swell potential.	Severe: clay texture; rippable bedrock at a depth of less than 15 inches.	Severe: high shrink-swell potential.
Manning: MaA, MaB	Slight [2]	Severe: moderately rapid permeability above gravel, rapid and very rapid permeability in gravel.	Moderate: gravelly substratum.	Slight	Severe: very rapid permeability in substratum.	Slight

See footnotes at end of table.

engineering properties of the soils—Continued

Suitability as source of—			Soil features affecting—					
Road fill	Sand or gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Fair: frost-heave potential.	Unsuitable	Good	Stratification; seepage potential.	Subject to piping	Not needed	Subject to flooding.	Not needed	Not needed.
Poor: high shrink-swell potential.	Unsuitable	Poor: silty clay and clay texture; poorly drained.	All features favorable.	High shrink-swell potential.	Claypan at a shallow depth.	Very slow permeability; ponded for part of each year.	Not needed	Not needed.
Fair: frost-heave potential.	Unsuitable	Good	Characteristics variable; onsite investigation needed; moderate permeability.	Fair compaction and stability.	Not needed	Subject to flooding.	Not needed	Not needed.
Poor: seasonal water table.	Unsuitable	Poor: seasonal water table; silty clay texture in places.	Characteristics variable; onsite investigation needed; suitable for dugout ponds.	Fair compaction and stability.	Seasonal water table.	Seasonal water table.	Not needed	Not needed.
Fair: frost-heave potential.	Unsuitable	Good	Moderate permeability.	Fair compaction and stability.	Not needed	All features favorable.	All features favorable.	All features favorable.
Fair: unstable material.	Unsuitable	Poor: sandy texture; high content of sodium.	Moderately rapid permeability in substratum in places.	Hazard of piping	Not needed	Slow permeability.	Unstable material for embankments; susceptible to siltation and soil blowing.	Vegetation difficult to establish; highly erodible.
Poor: high shrink-swell potential.	Unsuitable	Poor: clayey texture.	All features favorable.	High shrink-swell potential.	Not needed	Slow permeability.	Clayey texture; slow permeability.	Clayey texture; difficult to cultivate.
Fair: more than 30 percent fines.	Unsuitable	Good to a depth of 5 inches. Fair below a depth of 5 inches; sandy clay loam texture.	Moderate permeability.	Fair stability with controlled compaction.	Not needed	Hazard of water erosion; bedrock at a depth of 20 to 40 inches.	Rippable bedrock at a depth of 20 to 40 inches; susceptible to siltation and soil blowing.	Vegetation difficult to establish; highly erodible.
Good	Poor for sand and gravel: fines.	Good to a depth of 13 inches. Poor below a depth of 13 inches: sandy texture.	Moderately rapid and very rapid permeability.	Hazard of piping; high seepage.	Not needed	Low available water capacity.	Not needed	Not needed.
Poor: high shrink-swell potential.	Unsuitable	Poor: clay texture.	Slope	High shrink-swell potential.	Not needed	Slow permeability.	Not needed	Not needed.
Good	Poor for sand and gravel: fines.	Good	Moderately rapid permeability above substratum, very rapid permeability in gravelly substratum.	Fair to good compaction characteristics; hazard of piping.	Not needed	Low available water capacity.	Not needed	Not needed.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill (trench type) [1]	Local roads and streets
*Marmarth: MeB, MgC, MhB, MhC, MkA, MkB, MkC, Mm. For Cab bart part of MgC, see Cabbart series; for Rhame part of M hB and MnC, see Rhame series; for Rhoades part of MkA, MkB, and MkC, see Rhoades series; for Boxwell part of Mm, see Boxwell series.	Severe: rippable bedrock at a depth of 20 to 40 inches.	Moderate: moderate permeability.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate: moderate shrink-swell potential; rippable bedrock at a depth of 20 to 40 inches.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate: moderate shrink-swell potential; rippable bedrock at a depth of 20 to 40 inches.
*McKenzie: Mn, Mo. For Heil part oMo, see Heil series.	Severe: very slow permeability.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding; high shrink-swell potential.	Severe: subject to flooding.	Severe: poorly drained; high shrink-swell potential.
Mine dumps: Mp. Properties too variable to estimate. Onsite investigation needed.						
*Moreau: MrA, MrB, MwC. For Wayden part of MwC, see Wayden series.	Severe: slow permeability.	Slight where slopes are 0 to 3 percent. Moderate where slopes are 3 to 6 percent. Severe where slopes are more than 6 percent.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Severe: high shrink-swell potential.	Severe: clay texture; rippable bedrock at a depth of 20 to 40 inches.	Severe: high shirnk-swell potential.
Morton. Mapped only with Chama soils.	Severe: rippable bedrock at a depth of 20 to 40 inches.	Slight where slopes are 0 to 3 percent. Moderate where slopes are 3 to 6 percent. Severe where slopes are more than 6 percent.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate: moderate shrink-swell potential; rippable bedrock at a depth of 20 to 40 inches.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate: moderate shrink-swell potential; rippable bedrock at a depth of 20 to 40 inches.
Oburn: Ob	Severe above a depth of 36 inches: slow permeability in subsoil. Slight below a depth of 36 inches: rapid permeability.	Severe: rapid to very rapid permeability in substratum.	Moderate: gravelly substratum.	Slight	Severe: rapid to very rapid permeability in substratum in places.	Severe: high shrink-swell potential.
Parshall: PaA	Slight	Severe: moderate to moderately rapid permeability.	Slight	Slight	Severe: moderately rapid permeability.	Slight
Patent: PeB, PeC	Moderate: moderate permeability.	Moderate: moderate permeability.	Slight	Moderate: low to moderate shrink-swell potential.	Slight	Moderate: low to moderate shrink-swell potential.
*Reeder: ReA, ReB, RcC, RdA, RdB, RdC, Rf. For Cabba part of RcC, see Cabba series; for Rhoades part of RdA, RdB, and RdC, see Rhoades series; for Shambo part of ReA, ReB, see Shambo series; for Amor part of Rf, see Amor series.	Severe: rippable bedrock at a depth of 20 to 40 inches.	Moderate: moderate permeability.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate: moderate shrink-swell potential; rippable bedrock at a depth of 20 to 40 inches.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate: moderate shrink-swell potential; rippable bedrock at a depth of 20 to 40 inches.

See footnotes at end of table.

engineering properties of the soils—Continued

Suitability as source of—			Soil features affecting—					
Road fill	Sand or gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Fair: moderate shrink-swell potential.	Unsuitable	Good to a depth of 12 inches. Fair at a depth from 12 to 19 inches: clay loam texture.	Moderate permeability.	Moderate shrink-swell potential.	Not needed	Hazard of erosion; rippable bedrock at a depth of 20 to 40 inches.	Rippable bedrock at a depth of 20 to 40 inches.	Slopes in places.
Poor: high shrink-swell potential.	Unsuitable	Poor: clay texture; soluble salts.	All features favorable.	High shrink-swell potential.	High in soluble salts.	Very slow permeability; ponded for part of each year.	Not needed	Not needed.
Poor: high shrink-swell potential.	Unsuitable	Poor: clay texture.	Seepage potential in stratified beds in places.	High shrink-swell potential.	Not needed	Slow permeability; rippable bedrock at a depth of 20 to 40 inches.	Slow permeability.	Slopes in places.
Fair: moderate shrink-swell potential.	Unsuitable	Fair: silty clay loam texture.	Moderate permeability.	Moderate shrink-swell potential.	Not needed	Hazard of erosion; rippable bedrock at a depth of 20 to 40 inches.	Rippable bedrock at a depth of 20 to 40 inches.	Slopes in places.
Poor above a depth of 36 inches: high dispersion; high shrink-swell potential. Good below a depth of 36 inches.	Unsuitable	Good to a depth of 7 inches. Poor below a depth of 7 inches: clay texture; high content of sodium.	High seepage potential.	High shrink-swell potential.	Not needed	Slow permeability; claypan.	Not needed	Not needed.
Good	Unsuitable	Good	Moderately rapid permeability.	Hazard of piping.	Not needed	All features favorable.	Susceptible to siltation and soil blowing.	Highly erodible.
Fair: frost-heave potential.	Unsuitable	Good	Moderate permeability.	Fair compaction with moisture control; hazard of piping in places.	Not needed	Hazard of erosion.	Susceptible to siltation.	Slopes in places.
Fair: moderate shrink-swell potential.	Unsuitable	Good to a depth of 8 inches. Fair at depths from 8 to 17 inches: clay loam texture.	Moderate permeability.	Moderate shrink-swell potential.	Not needed	Hazard of erosion; rippable bedrock at a depth of 20 to 40 inches.	Rippable bedrock at a depth of 20 to 40 inches.	Steep slopes in places.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill (trench type) [1]	Local roads and streets
Regan: Rg	Severe: seasonal water table.	Severe: seasonal water table.	Severe: seasonal water table.	Severe: seasonal water table.	Severe: seasonal water table.	Severe: seasonal water table; poorly drained.
*Regent: RhA, RhB, RkC, RlB, RmA. For Moreau part of RkC, and RlB, see Moreau series; for Rhoades part of RlB and RmA, see Rhoades series.	Severe: slow permeability.	Slight where slopes are 0 to 3 percent. Moderate where slopes are 3 to 6 percent. Severe where slopes are more than 6 percent.	Moderate: clayey texture; rippable bedrock below a depth of 20 to 40 inches.	Severe: moderate to high shrink-swell potential.	Severe: clay texture; rippable bedrock below a depth of 20 to 40 inches.	Severe: moderate to high shrink-swell potential.
*Rhame: RnB, RoC, RoD. For Fleak part of RoC and RoD, see Fleak series.	Severe: rippable bedrock at a depth of 20 to 40 inches.	Severe: moderately rapid permeability.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate where slopes are 3 to 15 percent: rippable bedrock. Severe where slopes are more than 15 percent.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Slight where slopes are 3 to 9 percent: rippable bedrock at a depth of 20 to 40 inches. Moderate where slopes are 9 to 15 percent: rippable bedrock at a depth of 20 to 40 inches. Severe where slopes are more than 15 percent.
*Rhoades: RrA, RrB, Rt. For Absher part of RrA and RrB, see Absher series.	Severe: very slow permeability.	Slight where slopes are 0 to 3 percent. Moderate where slopes are 3 to 6 percent. Severe where slopes are more than 6 percent.	Severe: poor workability; more than 15 percent exchangeable sodium.	Severe: high shrink-swell potential; rippable bedrock below a depth of 20 to 40 inches.	Severe: clayey texture; rippable bedrock below a depth of 20 to 40 inches.	Severe: high shrink-swell potential.
Riverwash: Rw. Properties too variable to estimate. Onsite investigation needed.						
*Savage: SaA, ScA. For Rhoades part of ScA, see Rhoades series.	Severe: moderately slow permeability.	Slight where slopes are 0 to 3 percent. Moderate where slopes are 3 to 6 percent.	Moderate: silty clay loam or silty clay texture.	Severe: high shrink-swell potential.	Severe: silty clay loam or silty clay texture.	Severe: high shrink-swell potential.
Searing: SeB, SeC	Slight [2]	Severe: very rapid permeability in substratum.	Moderate: beds of porcellanite at a depth of 20 to 40 inches.	Moderate: beds of porcellanite at a depth of 20 to 40 inches.	Severe: rapid permeability in substratum.	Slight
Sham: Sg. Engineering properties are for Sham soil. Properties of the Gullied land part too variable to estimate.	Severe: slow permeability.	Slight where slopes are 0 to 3 percent. Moderate where slopes are 3 to 6 percent. Severe where slopes are more than 6 percent.	Slight where slopes are 0 to 9 percent. Moderate where slopes are 9 to 15 percent.	Moderate: moderate shrink-swell potential.	Slight	Moderate: moderate shrink-swell potential.

See footnotes at end of table.

engineering properties of the soils—Continued

Suitability as source of—			Soil features affecting—					
Road fill	Sand or gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Poor: high frost-heave potential; moderate shrink-swell potential.	Unsuitable	Poor: poorly drained; soluble salts.	All features favorable.	Moderate shrink-swell potential; poorly drained.	Inadequate outlets; seasonal water table.	Seasonal water table.	Not needed	Not needed.
Poor: high shrink-swell potential.	Unsuitable	Fair to a depth of 7 inches. Poor below a depth of 7 inches: clay texture.	Slow permeability.	Moderate to high shrink-swell potential.	Not needed	Slow permeability.	Slow permeability; rippable bedrock at a depth of 20 to 40 inches.	Slopes in places.
Good	Unsuitable	Good where slopes are 3 to 9 percent. Fair where slopes are 9 to 15 percent. Poor where slopes are more than 15 percent.	Moderately rapid permeability.	Fair to good compaction characteristics; hazard of piping.	Not needed	Low to moderate available water capacity.	Susceptible to siltation and soil blowing.	Slopes in places; highly erodible.
Poor: high shrink-swell potential.	Unsuitable	Poor: limited amount of suitable material over claypan.	All features favorable.	High shrink-swell potential; susceptible to sliding.	Not needed	Dense claypan at a depth of less than 10 inches; very slow permeability.	Dense claypan; unstable material for embankments.	Dense claypan; vegetation difficult to establish.
Poor: high shrink-swell potential.	Unsuitable	Fair to a depth of 6 inches. Poor to a depth of 22 inches silty clay loam or silty clay texture.	All features favorable.	High shrink-swell potential.	Not needed	Moderately slow permeability.	Silty clay loam or silty clay texture.	Silty clay loam or silty clay texture; difficult to cultivate.
Fair: frost-heave potential.	Unsuitable	Good	Moderate permeability in upper 28 inches; rapid permeability below a depth of 28 inches.	Poor stability; upper 24 inches can be used under close control; moderate permeability.	Not needed	Rapid permeability below a depth of 28 inches.	Rapid permeability in substratum; bedrock at depth of 20 to 40 inches.	Not needed.
Fair: moderate shrink-swell potential.	Unsuitable	Poor: high content of sodium.	All features favorable.	Moderate shrink-swell potential.	Not needed	Slow permeability; highly susceptible to water erosion.	Unstable material for embankments; potential for siltation of channels.	Vegetation difficult to establish; highly erodible.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill (trench type) [1]	Local roads and streets
*Shambo: ShA, ShB, SlA, SlB, SmA—For Arnegard part of SlA, and SlB, see Arnegard series. For Belfield and Rhoades parts of SmA, see Belfield and Rhoades series.	Slight	Severe: rapid permeability.	Slight	Moderate: low to moderate shrink-swell potential.	Slight	Moderate: low to moderate shrink-swell potential in upper 4 feet.
*Stady: SnA, SrB, SsA—For Lehr part of SrB, see Lehr series; for Shambo part of SsA, see Shambo series.	Slight [2]	Severe: moderately rapid permeability above substratum, very rapid permeability in gravelly substratum.	Moderate: gravelly substratum.	Slight	Severe: very rapid permeability in substratum.	Slight
Straw—Mapped only with Korchea soils.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
*Tally: TaB, TaC, TdA—For Parshall part of TdA, see Parshall series.	Slight	Severe: moderately rapid permeability.	Slight	Slight	Severe: moderately rapid permeability.	Slight
*Telfer: Te, TfC—For Flasher part of TfC, see Flasher series.	Slight	Severe: rapid permeability.	Severe: sandy texture.	Slight	Moderate: rippable bedrock at a depth of less than 60 inches.	Slight
Toby: ToA, ToB, ToC, TrA	Slight	Severe: moderately rapid permeability.	Slight	Slight	Severe: moderately rapid permeability.	Slight
Tusler—Mapped only with Fleak and Zeona soils.	Severe: rippable bedrock at a depth of 20 to 40 inches.	Severe: rapid permeability.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate where slopes are 9 to 15 percent: rippable bedrock at a depth of 20 to 40 inches. Severe where slopes are more than 15 percent.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Slight
*Vebar: VfC, VfD, VtB—For Flasher part of VfC and VfD, see Flasher series; for Tally part of VtB, see Tally series.	Severe: rippable bedrock at a depth of 20 to 40 inches.	Severe: moderately rapid permeability.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Moderate where slopes are 9 to 15 percent; rippable bedrock at a depth of 20 to 40 inches. Severe where slopes are more than 15 percent.	Moderate: rippable bedrock at a depth of 20 to 40 inches.	Slight where slopes are 0 to 9 percent. Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.
Velva: Vv	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.

See footnotes at end of table.

engineering properties of the soils—Continued

Suitability as source of—			Soil features affecting—					
Road fill	Sand or gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Fair: frost-heave potential.	Unsuitable	Good	Moderate permeability; moderately rapid permeability in substratum in places.	Fair compaction and stability.	Not needed	All features favorable.	All features favorable.	All features favorable.
Good	Poor for sand and gravel; fines.	Good	Very rapid permeability in substratum.	Fair to good compaction characteristics; hazard of piping.	Not needed	Low available water capacity.	Not needed	Not needed.
Fair: frost-heave potential.	Unsuitable	Good	Moderate permeability; site characteristics variable; on-site investigation needed.	Fair compaction and stability with control.	Not needed	Subject to flooding.	Not needed	Not needed.
Fair: more than 30 percent fines.	Unsuitable	Good	Moderately rapid permeability.	Hazard of piping.	Not needed	Hazard of erosion.	Not needed	Not needed.
Good	Unsuitable	Poor: sandy	Rapid permeability.	Rapid permeability; hazard of piping.	Not needed	Low available water capacity.	Not needed	Not needed.
Fair: more than 30 percent fines.	Unsuitable	Good where slopes are less than 9 percent. Fair where slopes are 9 to 15 percent.	Moderately rapid permeability.	Fair to good compaction characteristics; hazard of piping.	Not needed	Hazard of erosion.	Not needed	Not needed.
Good where slopes are 0 to 15 percent. Fair where slopes are 15 to 25 percent. Poor where slopes are more than 25 percent.	Unsuitable	Poor: loamy fine sand texture.	Rapid permeability.	Fair to good compaction characteristics; hazard of piping.	Not needed	Low available water capacity; rippable bedrock at a depth of 20 to 40 inches.	Not needed	Not needed.
Fair: more than 30 percent fines.	Unsuitable	Fair where slopes are 9 to 15 percent.	Moderately rapid permeability.	Fair to good compaction characteristics; hazard of piping.	Not needed	Low to moderate available water capacity; hazard of erosion.	Soft bedrock at a shallow depth.	Steep in places; highly erodible.
Fair: more than 30 percent fines.	Unsuitable	Good	Moderate permeability.	Hazard of piping.	Not needed	Subject to flooding.	Not needed	Not needed.

TABLE 7.—*Interpretations of*

Soil series and map symbols	Degree and kind of limitation for—					
	Septic tank absorption fields	Sewage lagoons	Shallow excavations	Dwellings with basements	Sanitary landfill (trench type) [1]	Local roads and streets
Wabek: Wa	Slight [2] where slopes are 0 to 9 percent. Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.	Severe: rapid permeability above substratum; very rapid permeability in the gravelly substratum.	Severe: gravelly substratum; subject to sloughing.	Slight where slopes are 3 to 9 percent. Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.	Severe: rapid permeability to gravel; very rapid permeability in substratum.	Slight where slopes are 0 to 9 percent. Moderate where slopes are 9 to 15 percent. Severe where slopes are more than 15 percent.
Watrous: Wm	Severe: rippable bedrock at a depth of 20 to 40 inches.	Severe: hard bedrock at a depth of 20 to 40 inches.	Severe: onsite investigation needed; rippable bedrock in places.	Severe: hard bedrock at a depth of 20 to 40 inches; rippable bedrock in places.	Severe: hard bedrock at a depth of 20 to 40 inches.	Severe: hard bedrock at a depth of 20 to 40 inches.
*Wayden: WoC For Moreau part of WoC, see Moreau series.	Severe: rippable bedrock at a depth of less than 20 inches.	Moderate where slopes are 3 to 6 percent. Severe where slopes are more than 6 percent.	Severe: poor workability; clay texture; rippable bedrock at a depth of less than 20 inches.	Severe: high shrink-swell potential; rippable bedrock at a depth of less than 20 inches.	Severe: clayey texture; rippable bedrock at a depth of less than 20 inches.	Severe: high shrink-swell potential.
Wolf Point: Wp	Severe: [2] slow permeability.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.	Severe: subject to flooding.
Yawdim: YaC	Severe: rippable bedrock at a depth less than 20 inches.	Moderate where slopes are 3 to 6 percent. Severe where slopes are more than 6 percent.	Severe: poor workability; silty clay texture; rippable bedrock at a depth of less than 20 inches.	Severe: high shrink-swell potential.	Severe: silty clay texture; rippable bedrock at a depth of less than 20 inches.	Severe: high shrink-swell potential.
*Zeona: Zd, ZeC, ZfB, ZtC For Tusler part of ZtC, see Tusler series.	Slight [2]	Severe: rapid permeability.	Severe: loose to a depth of more than 60 inches in places; high slough potential.	Slight where slopes are 3 to 9 percent. Moderate where slopes are 9 to 15 percent.	Severe: rapid permeability.	Slight

[1] Onsite studies of the underlying strata, water table, and potential of aquifer pollution and drainage into ground water need to be made for landfills deeper than 5 or 6 feet.

engineering properties of the soils—Continued

Suitability as source of—			Soil features affecting—					
Road fill	Sand or gravel	Topsoil	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
Good where slopes are 0 to 15 percent. Fair where slopes are 15 to 25 percent. Poor where slopes are more than 25 percent.	Fair for sand: fines. Poor for gravel: more fines than desirable.	Poor: limited amount of suitable material.	Rapid permeability above substratim, very rapid permeability in substratum.	Moderate permeability when compacted.	Not needed	Very low available water capacity.	Not needed	Not needed.
Fair: moderate shrink-swell potential.	Unsuitable	Good to a depth of 7 inches. Fair at a depth from 7 to 22 inches: clay loam texture.	Moderate permeability bedrock at a depth of 20 to 40 inches.	Fair stability and compaction with moisture control.	Not needed	Bedrock at a depth of 20 to 40 inches.	Not needed	Not needed.
Poor: high shrink-swell potential.	Unsuitable	Poor: silty clay loam and silty clay texture.	Slow permeability.	High shrink-swell potential.	Not needed	Rippable bedrock at a depth of less than 20 inches; slow permeability.	Not needed	Silty clay loam and silty clay texture; difficult to cultivate; vegetation difficult to establish.
Poor: high shrink-swell potential.	Unsuitable	Poor: clay texture.	Slow permeability.	High shrink-swell potential.	Not needed	Slow permeability.	Not needed	Not needed.
Poor: high shrink-swell potential.	Unsuitable	Poor: silty clay texture.	Slow permeability.	High shrink-swell potential.	Not needed	Rippable bedrock at a depth of less than 20 inches; slow permeability.	Not needed	Silty clay texture; difficult to cultivate; vegetation difficult to establish.
Good where slopes are 0 to 15 percent. Fair where slopes are 15 to 25 percent.	Unsuitable for gravel. Fair for sand: fines.	Poor: sandy texture.	Rapid permeability.	Hazard of piping; fair to good compaction; moderate to high permeability when compacted.	Not needed	Very low to low available water capacity.	Not needed	Not needed.

[2] Pollution of water supply is a hazard.

excavations deeper than the depths of layers here reported. Even in such situations, the soil map is useful for planning more detailed field investigations and for suggesting the kinds of problems that may be expected.

Some of the terms used in soil science, such as clay, silt, and sand, have different meanings than the same terms used in engineering. These terms and others are defined in the Glossary.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system, used by the SCS engineers, Department of Defense, and others (*7*); and the AASHO system, adopted by the American Association of State Highway Officials (*1*).

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. Soils are grouped into 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes, for example, ML–CL.

The AASHO system is used to classify soils according to those properties that affect their use in highway construction and maintenance. In this system a soil is placed in one of seven basic groups ranging from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, the best soils for subgrade (foundation). At the other extreme, in group A–7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b, A–2–4, A–2–5, A–2–6, A–2–7, A–7–5, and A–7–6. As an additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 to for the best material to 20 or more for the poorest. The AASHO classification in table 5 includes the group number for the soils tested.

Engineering test data

Soil samples, representing 11 soil series, taken from 20 profiles in Bowman County, were tested in accordance with standard procedures to help evaluate the soils for engineering purposes. The results of those tests are shown in table 5.

Moisture-density data are obtained by compacting soil material at a successively higher moisture content. Assuming that the compactive effort remains constant, the density of the compacted material increases until the optimum moisture content is reached. After that, the density decreases with increase in moisture content. The highest dry density obtained in the compaction test is the *maximum dry density*, and the corresponding moisture content is the *optimum moisture*. Moisture-density data are important in earthwork because, as a rule, optimum stability is obtained if the soil is compacted to about the maximum dry density at approximately optimum moisture content.

The tests for plastic limit and liquid limit measure the effect of water on the consistence of the soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from a semisolid to a plastic state. As the moisture content is further increased, the material changes from a plastic to a liquid state. The *plastic limit* is the moisture content at which the soil material passes from a semisolid to a plastic state. The *liquid limit* is the moisture content at which the material passes from a plastic to a liquid state. The *plasticity index* is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which a soil material is plastic.

Soil properties significant to engineering

Several estimated soil properties significant to engineering are given in table 5. These estimates are made for typical soil profiles, by layers sufficiently different to have different significance for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Explanation of some of the columns in table 6 follow.

Depth to bedrock is the distance from the surface of the soil to the upper surface of soft-bedded sandstone, shale, and siltstone.

Depth to seasonal water table is the distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Table 6 describes soil texture in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. Loam, for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loamy sand." Sand, silt, clay, and some of the other terms used in USDA textural classification are defined in the Glossary.

Permeability is that quality of a soil that enables water or air to move through it. The estimates are based on soil characteristics observed in the field, mainly structure and texture. The estimates in table 6 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crop plants.

Reaction refers to the degree of acidity or alkalinity of a soil. Soils that have a pH of less than 8.5 are likely to have higher consolidation potential and better shear strength than other soils. A high degree of alkalinity in soils, particularly if the pH is more than 8.5, promotes dispersion.

The soils that are shown in table 6 as having moderate to high salinity contain gypsum. Gypsum is not harmful if the soil material is to be used as borrow material, but if it is to be used in foundations, it is critical because abnormal porosity may result when the crystals dissolve.

Shrink-swell potential indicates the volume change to be expected when the moisture content changes. It is based on the liquid limit and plasticity index of the soil. Shrink-swell potential is low if the liquid limit is 30 or less and the plasticity index is 10 or less; it is moderate if the liquid limit is 31 to 40 and the plasticity index is 11 to 20; and it is high if the liquid limit is 41 to 60 and the plasticity index is 21 to 40. The shrink-swell potential of coarse sand and gravel is so low that they are designated as having none.

Corrosivity is a chemical reaction detrimental to structural materials, such as concrete or uncoated steel, if buried in the soil. Concrete may be affected by the presence of certain acid salt crystals, such as sodium and magnesium sulfates, which are quite soluble. The salt solution enters the pores of concrete and, as it dries, reforms into crystals that expand and rupture the concrete and cause deterioration.

The rusting or corrosion of uncoated steel when in contact with soil is a process of oxidation. This process needs the presence of both air and water. The total soil acidity, soil drainage, and soil texture affect this process.

Engineering interpretations of soils

In table 7 ratings are used to summarize the limitations of the soils for such uses as septic tank absorption fields, sewage lagoons, and local roads and streets. Soil limitations are indicated by the ratings slight, moderate, and severe. *Slight* means soil properties generally are favorable for the rated use, or, in other words, limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means soil properties so unfavorable and so difficult to correct or overcome as to require major soil reclamation and special designs. The suitability of the soils as a source of road fill, sand or gravel, and topsoil is also rated. Table 7 also lists features that affect use of the soils for such purposes as pond reservoir areas, drainage, and irrigation. Column headings in table 7 are discussed briefly in the following paragraphs.

Septic tank absorption fields.—The effectiveness of septic tank absorption fields is influenced by the ease of downward movement of effluent through the soil. If permeability is slow, a soil is rated severe. Other soil properties that influence the effectiveness of septic tank absorption fields are hazard of flooding, seasonal high water table, salinity and alkalinity, and topography.

Sewage lagoons.—Sewage lagoons require evaluation of the soil as a vessel for the impounded area and as soil material for the dam. Adequate soil material that is suitable for the structure must be available, and if properly constructed the lagoon must be capable of holding water with minimum seepage. Soils that are subject to flooding have severe limitations as sites for lagoons. Floodwaters interfere with the functioning of the lagoon and carry away sewage before bacterial decomposition takes place. Pollution of streams may be a main concern.

Shallow excavations.—Shallow excavations are those that require excavating or trenching to a depth of 6 feet or less and are used for underground utility lines, cemeteries, open ditches, and similar purposes. Desirable soil qualities and characteristics are good workability, moderate resistance to sloughing, gentle slopes, and no flooding.

Dwellings with basements.—Soil limitation ratings for foundations of dwellings that have basements are for undisturbed soils that have been evaluated for single family dwellings and other structures that have similar foundation requirements. Buildings of more than three stories and other buildings that have foundation loads greater than those of three-story buildings are not rated. In rating soils for dwellings, the emphasis is on foundations; but soil slope, susceptibility to flooding, and other hydrologic conditions, such as seasonal wetness, that have effects beyond those related exclusively to foundations are also considered. Properties that affect bearing strength and settlement of the natural soil are density, wetness, flooding, plasticity, texture, and shrink-swell behavior. Onsite investigations are needed for specific placement of buildings and utility lines and for detailed design or foundations. All ratings are based on undisturbed soils to a depth of 5 feet.

Sanitary landfills.—There are two types of sanitary landfill, the trench type and the area type. The trench type of sanitary landfill is a dug trench in which refuse is buried. The refuse is covered with at least a 6-inch layer of compacted soil material. In the area type of landfill operation, however, refuse is placed in successive layers on the surface of the soil. Daily and final cover material is imported unless trenches are dug to obtain cover material.

Soil surveys are a valuable tool in selecting potential alternate sites for a proposed sanitary landfill operation. They are not a substitute for detailed geologic investigations, because soil borings are normally limited to a depth of 5 or 6 feet and they therefore do not provide data from greater depths that may be needed.

Soil surveys are especially useful in preliminary determinations of those sites that are not well suited to sanitary landfill operations and save the time and expense of more detailed investigations. Soil surveys can also indicate sites where soils are favorable and additional investigations appear warranted.

Properties affecting use for sanitary landfills are depth to seasonal high water table, soil drainage, hazard of flooding, depth to bedrock, permeability, and slope.

Local roads and streets.—Soils are evaluated for construction and maintenance of local roads and streets. These are improved roads and streets that have all-weather surfacing, commonly asphalt or concrete, and that are expected to carry automobile traffic all year. Not under consideration are highways designed for fast-moving heavy trucks. Properties that affect design and construction of such roads and streets are those that affect the load-supporting capacity and stability of the subgrade and those that affect the workability and amount of cut and fill. Wetness and flooding affect stability. Slope, depth to hard rock, stoniness, and wetness affect ease of excavation and the amount of cut and fill needed to reach an even grade.

Road fill.—Road fill is soil material used for making embankments for roads. This interpretation requires predictions of how well a soil will perform after it has been

moved from its original location and placed in a road embankment. It also requires evaluation of soil characteristics, such as slope, that affect the ease with which the soil can be removed.

Sand and gravel.—The suitability of a soil as a source of sand or gravel depends on the quality of the material for road construction and for use as concrete aggregate. Also, to qualify as either a good or fair source, the sand or gravel layer should be at least 3 feet thick. Soils that are shown as suitable should be explored extensively to find material that meets gradation requirements for specific uses.

The sand and gravel material found in Bowman County generally is limited in quantity and quality. It is poorly suited to use as concrete aggregate because of excessive fines. The material from some of the pits has been mixed with local soil material to produce a satisfactory base course for road pavements. Material from some pits, after some processing, has also been mixed with bituminous material to produce a satisfactory pavement for roads.

Topsoil.—Good topsoil has physical, chemical, and biological characteristics favorable for the establishment and growth of suited plants. It is friable and easy to handle and spread. Generally, only the surface layer is rated. If all other characteristics are favorable, topsoil less than 6 inches thick is rated poor, and topsoil as much as 12 inches thick is rated good.

Pond reservoir areas.—Factors considered in evaluating soil for pond reservoir areas are those properties of undisturbed soils that affect their suitability for water impoundments. Soil properties most important are permeability, depth to water table, and depth to bedrock.

Embankments, dikes, and levees.—Properties considered in evaluating soil for embankment material are those properties of undisturbed soils that affect their suitability for constructing earthfills. These properties include compaction characteristics, permeability when compacted, piping hazard, and salinity and alkalinity.

Drainage.—Factors considered in evaluating a soil for drainage are those properties that affect the installation and performance of surface and subsurface drainage practices. The soils listed are somewhat poorly drained to very poorly drained and have a seasonal or permanent high water table. They have severe limitations for crop production because saturation of the soil with water excludes air from plant roots and only permits the growth of water-tolerant plants.

Irrigation.—Soil features and qualtities considered in determining suitable irrigation practices are mainly available water capacity, water intake rate, soil slope, and natural drainage. The type of irrigation, sprinkler or gravity, was not considered in the evaluation. Soils that have low available water capacity require frequent applications of water to maintain a rapid rate of plant growth. Slowly permeable soils are somewhat difficult to irrigate because water must be applied very slowly to allow the water to soak into the soil and to avoid runoff.

Terraces and diversions.—Factors considered in evaluating soils for diversions and terraces are those properties that affect stability or hinder layout and construction.

Grassed waterways.—Factors considered in evaluating soils for waterways are those properties that affect the establishment, growth and maintenance of plants and hinder layout and construction.

Formation and Classification of Soils

This section has two main parts. The first part describes how the factors of soil formation have affected the development of soils in Bowman County. The second part explains the system of soil classification and classifies each soil in the county according to that system.

Factors of Soil Formation

Soil is produced by soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material; the climate under which the soil material has accumulated and existed since accumulation; the plant and animal life on and in the soil; the relief, or lay, of the land; and the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, though mainly plant life, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons, which make up the profile. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. Some time is always required for the differentiation of soil horizons, but generally a long time is required for the development of distinct horizons.

The five factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

A major part of the soils in Bowman County formed in sedimentary material laid down millions of years ago. Most of the material was laid down during the Cretaceous and Tertiary Periods.

The most recent deposits consist of sand dunes and of silt, sand, and gravel on the flood plains of the rivers and the larger creeks in the county. The material of the older formations was deposited millions of years ago, during a time when the central part of the United States was an ocean. The rivers in the adjacent land areas washed sand, silt, and clay into the water, and these materials settled to the bottom of the ocean. The ocean gradually filled with these materials, producing the formations in the county. The materials that became sedimentary rock were laid down in strata varying from less than 1 foot to several feet in thickness. These layers range from sand to clay in texture and cause stratified soil profiles in many places. This process, along with a movement of the earth's

crust, formed a new land area. After the new land area had been exposed, various erosion processes and more movement of earth's crust exposed the older formations. These processes have been more active in the western part of Bowman County, where the older formations are exposed. In crossing the county from east to west, it is possible to study these different formations in many places where they are on the surface or have been exposed by the cutting of rivers and geologic erosion.

The oldest formation in Bowman County is the Pierre Shale Formation (*2*). More than 400 feet of the dark-gray marine shale of the Pierre Shale age is exposed because of an uplift, which is referred to as the Cedar Creek anticline. The shale is soft, crumbly rock that weathers to form low, smoothly rounded hills and smooth-sided valleys. The Dilts and Lisam clays that formed in this formation are extremely poor and support only a sparse growth of vegetation, mainly spike wheatgrass, salt sage, and cactus. Ranchers and farmers seldom locate on this shale.

The Fox Hill Formation lies conformably on the Pierre Shale. Its rusty-brown color is in contrast to colors of other associated formations. This formation weathers to form Ekalaka and Rhame soils in contrast to the Dilts and Lisam clays of the Pierre Shale Formation. The Ekalaka and Rhame soils support more and better vegetation and less sage brush and cactus than Dilts and Lisam clays.

Directly above the Fox Hill Formation lies the Hell Creek Formation of the Late Cretaceous Period. It consists of stratified layers of sandstone, shale, and bentomite clay. Sandstone and sandy shale are the dominant rocks of this formation. The sandstone is gray, yellow, and brown. The formation weathers to rounded hills that protrude through rough, irregular, grassed areas of Ekalaka, Zeona, and Rhame soils.

Approximately two-thirds of the county is covered with the Fort Union Formation, which is subdivided into the Ludlow and the Tongue River Members. The Ludlow Member is the lower of the two and overlies the Hell Creek Formation. The Ludlow Member outcrops in a band that lies east of the Badlands and extends in a southeasterly direction into Adams County and then into South Dakota. In the southeast corner of the county, along the breaks of the North Fork of the Grand River, the Ludlow Member grades into the Cannonball Member.[7] In places the Ludlow Member consists of alternating layers of shale, sandstone, and lignite beds. This member weathers to form a gently undulating plain that has an occasional butte or range of smooth hills. It formed more productive soils, many of which are cultivated and are better suited to dry farming than those of the Hell Creek Formation. The Ludlow Member generally is a dusky bluish gray, which is in contrast to the light-colored layers of shale and sandstone of the Tongue River Member.

The Tongue River Member covers about two-fifths of the county. It consists of stratified layers of sandstone, shale, and lignite beds. Some of the sandstone is highly calcareous. The sandstones are mostly light shades of tan, buff, cream, yellow, and white in color. Most of the shale is light colored, but it has some gray, brown, drab, and black. This member weathers to a gently sloping plain that has an occasional butte or range of smooth hills. It formed some of the most productive and easily tilled soils in the county. Among these are soils of the Amor, Reeder, and Regent series.

Remnants of the younger Golden Valley and White River Formations are on and around Talbert Butte and on the plateau surfaces of the Medicine Pole Hills.

The parent materials range from yellow to dark olive gray (Fort Union Formation) and dark gray (Pierre shale Formation). Most of the materials in the Fort Union Formation contain a large percentage of carbonates. The carbonates are evident in Amor loam and Chama silty clay loam, which formed from this formation. The lignite beds of the various formations have contributed little to the characteristics of any soils. Beds of red, bricklike fragments of baked shale, locally known as scoria (porcellanite), are the parent material of the Brandenburg and Searing soils. These soils are not extensive.

Saline strata in the geologic strata formed the saline soils of the Regan series and strongly saline land that have poor drainage and in most places a high water table. A saline soil of mainly calcium salts will improve if it is drained and the salts are removed. A saline soil having sodium salts and some subsurface drainage will have the clay moved into the B horizon or claypan by leaching, as in soils of the Absher, Daglum, Heil, and Rhoades series. These soils are on a landscape that has a pitted microrelief in which the highs are 12 inches above the lows in extreme cases. This condition results partly from differences in the extent to which salt has intruded and removed soil and partly from the effects of differential erosion of the eluviated layer.

The soils of the Rhoades series differ distinctly from one another in the thickness of the A horizon and in the development of the B horizon and the amount of sodium it contains. These differences are brought about in the following ways: (1) material is deposited over the claypan layer of the columnar B horizon; (2) there is differential soil blowing and water erosion of the A horizon; and (3) sodium is removed from the upper part of the B horizon, resulting in leaching of its clays and organic matter and the formation of a platy, gray A horizon. As the degradation process continues, the columnar layer is lost and only a blocky structure remains. In some places, improved drainage helps leaching. If profiles are studied in a pit or trench, the differences in profiles and depth to salts can readily be seen. Most of the soils in Bowman County influenced by salts are included in the complexes of claypan and more arable soils.

The claypan (alkali) soils in Bowman County are in the Absher, Belfield, Daglum, Desart, Ekalaka, Ladner, Oburn, and Rhoades series.

Some of the coarse-textured soils in Bowman County lack the structural B horizon development of most of the soils in the area because the parent materials lack the clay content for the consistency needed to form peds. Examples are soils of the Zeona series.

The clay shales of the Fort Union Formation and the clayey alluvium deposits on flats of the high low terraces

[7] This member is of marine origin and is exposed in only a very small area in Bowman County.

weathered to form the clayey (more than 35 percent clay) soils of the Heil, Lawther, McKenzie, Moreau, Regent, and Savage series.

The silty shales, sandy shales, and argillic sandstones weathered to form the loamy soils of the Amor, Boxwell, Cabba, Cabbart, Chama, Marmarth, Morton, and Reeder series. Some of the loamy soils of the Arnegard, Grail, Havre, Korchea, Kremlin, Shambo, and Straw series formed in loamy alluvial and in local mantle deposits.

The sandstone of the various formations weathered and formed the moderately coarse and coarse, sandy soils of the Flasher, Fleak, Lefor, Rhame, Telfer, Vebar, and Zeona series. Some moderately coarse and coarse textured soils of the Glendive, Parshall, Tally, Toby, and Velva series formed in alluvial and local mantle deposits.

Climate

Climate is one of the active forces in the formation of the soils of Bowman County. Climate, vegetation, and other soil-forming processes have changed the raw materials to a natural body with related layers. Differences in relief have helped or hindered these processes.

The soils of Bowman County formed under a continental, semiarid climate. Temperatures are sometimes extreme, and annual precipitation varies. The average annual temperature at Bowman is 42.9° F. In most years, for about 4½ months the ground is frozen, at which time weathering and decomposition of mineral and organic matter virtually stop.

The average annual precipitation is from 15 to 16 inches in the eastern part of the county and less than 14 inches in the western part. Native grasses were therefore more dense in the east, where the dark grayish-brown Shambo, Reeder, and Vebar soils formed, and less dense in the west, where the grayish-brown Kremlin, Marmarth, and Rhame soils formed. Fifty percent of the precipitation falls during June, July, and August as sudden, intense thunderstorms. Extended periods of drought occur. Ground moisture is seldom sufficient to completely moisten the soils. At a depth of 3 feet, the soils are comparatively dry most of the time, except those on bottom lands or in areas that receive run-in water.

The average windspeed in Bowman County is 11 miles per hour, and the prevailing winds are from a west-northwesterly direction.

The climate of Bowman County favors the accumulation of organic matter and the retention of bases high in the soil profiles. Climate influences soil formation both directly and indirectly. Directly, climate has affected the weathering and reworking of parent materials through temperature, rainfall, and wind. Indirectly, it has affected the soils through the amount of vegetation and animal life it supports.

Chemical reactions in the soils and weathering of parent materials are most active in summer. During the summer, moisture and temperature conditions are the most favorable for these processes. Droughts have had their effect on the soils in Bowman County, and during extreme droughts plant growth and the weathering of soil stop. The effect of droughts, combined with blowing for a period of time, has affected the physical and chemical properties of the Zeona soils. The Reeder, Shambo, Savage, and Regent soils are leached of carbonates to an average depth of less than 20 inches. Because the soils in Bowman County are subject to little leaching, many have accumulated moderate to high amounts of organic matter and humus in the surface layer. In most places this layer is very dark grayish brown when moist. Alternate wetting and drying and freezing and thawing have aided in the formation of a prismatic soil structure in the subsoil of the Reeder and Marmarth soils.

Plants and animals

All forms of life, in and on the soil, have influenced the chemical and biological processes in the soils of Bowman County. The county's environment supports only a moderate growth of grasses and mostly favors the mid and short grasses. Tall grasses are limited in extent, but some steep east-facing slopes have tall grass because the soils receive additional moisture from snow drifts that have accumulated as a result of the prevailing northwesterly winds. Conditions for the growth of grass are most favorable on Arnegard loam, which is high in organic-matter content, deep, and friable. Conditions for plant growth are the least favorable on Dilts clay and Lisam clay, which are low in organic matter.

The color of the soils, their organic-matter content, and their physical and chemical properties are partly the result of the native grass cover. The dark grayish-brown surface layer of the Shambo and Reeder soils is a result of dead grass.

In the soil-forming process dead grass was the main source of organic matter. The grass was decomposed in the soil by micro-organisms, insects, small animals, and chemical action. Micro-organisms in the soil change the plant material and organic matter into stable humus, from which other plants obtain nutrients. In places, earthworms and small burrowing animals have influenced soil formation by mixing the soil materials; also, their remains have increased the organic-matter content.

Relief

Relief in Bowman County has played an important part in soil formation, especially in the western half of the county. It has affected the relationship between temperature and water and erosion and vegetation. Vegetation varies on different positions on the landscape. In most places where positions have a more favorable moisture relationship, the amount and vigor of the grass increases. Arnegard loam, nearly level, is an example of a soil that receives extra moisture from adjacent slopes. Relief, therefore, dominates the influences of climate and vegetation in the formation of soils. The steeper Cabba soils absorb less moisture and lack the B horizon of the more gently sloping Reeder soils because the continual erosion of the steeper soils tends to retard the soil-forming processes. Other steep soils are those of the Cabbart, Flasher, and Fleak series.

Arable soils containing a B horizon formed on nearly level to gently sloping reliefs where runoff is ample, but not rapid, and percolation is good. Examples are the Marmarth, Morton, Reeder, Regent, Rhame, Vebar, Savage, and Shambo soils.

Several soils can form in the same material, even though this material is at different positions on the

landscape. In undulating relief on the hilltops, knolls, and ridges are soils that have a thin A horizon. On side or mid slopes are the thicker, well-developed soils that have a thicker A horizon and B horizon and a deeper lime zone. On the swales and lower slopes are soils that contain a very thick, dark-colored A horizon. Examples of these soils are Cabba loams on crests, Amor loams on mid slopes, and Arnegard loams on lower slopes.

On flat areas where surface drainage is restricted and permeability is slow, the Heil soils show gleying and mottling.

The relief in Bowman County was shaped by the natural processes of erosion.

Time

The arable soils of Bowman County that have a B horizon required a long time to form genetic layers. The time required for formation of a soil having genetic horizons depends largely on the other soil-forming factors. Because Bowman County is semiarid, and the ground is frozen 4½ months each year, more time is required for formation of soil that has genetic horizons in this county than in warm, humid areas. More time is also required for a soil to form in fine-textured materials than in coarse-textured materials.

Soil age is determined somewhat by the degree of slope and not by the number of years the soil has been exposed. The steeply sloping soils of the Flasher and Cabba series lack the genetic horizons of the gently sloping Reeder and Vebar soils. Where the slopes are steeper, erosion removes the soil, and water runs off instead of entering the soil. In such places, time has had little effect in the formation of genetic layers.

The Morton, Reeder, Regent, Savage, Shambo, and Vebar soils needed a long time to form A, B, and C horizons.

The Shambo soils in flat areas that are high above the present drainage may be much older than some of the deep, arable, gently sloping soils. They have not been truncated by erosion and have not received new material from areas above.

Recent alluvial soils, such as Havre soils, show little, if any, formation of a B horizon.

Classification of Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us understand their behavior and their response to manipulation. First through classification and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

Thus, in classification, soils are placed in narrow categories that are used in detailed soil surveys so that knowledge about the soil can be organized and used in managing farms, fields, and woodland; in developing rural areas; in engineering work; and in many other ways. Soils are placed in broad classes to facilitate study and comparison of large areas, such as countries and continents.

The classification system used in this survey was adopted for general use by the National Cooperative Soil Survey in 1967 and is under continual study. Therefore, readers interested in developments of the system should search the latest literature available (*3*, *5*). In table 8, the soil series of Bowman County are placed in some categories of this system.

This system has six categories. Beginning with the broadest, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that soils of similar genesis, or more or origin, are grouped together. Most of the classes of the current system are briefly defined in the following paragraphs.

ORDERS: Ten soils orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Utisols, Oxisols, and Histosols. The properties used to differentiate these soil orders are those that tend to give broad climatic groupings of soils. The two exceptions to this are the Entisols and Histosols, which occur in many different climates. Table 8 shows the four soil orders in Bowman County: Entisols, Aridisols, Mollisols, and Inceptisols.

Entisols are light-colored soils that do not have natural genetic horizons or that have only weakly expressed beginnings of such horizons. These soils do not have characteristics that reflect soil mixing caused by shrinking and swelling.

Aridisols are light-colored mineral soils that are high in bases, and they have well-expressed mineral genetic horizons.

Mollisols formed under grass and have a thick, dark-colored surface horizon containing colloids dominated by bivalent cations. This soil material has not been mixed by shrinking and swelling.

Inceptisols most commonly occur on young, but not recent, land surfaces and generally are moist. The direction of soil development generally is not evident from the marks left by various soil-forming processes.

SUBORDERS: Each order has been subdivided into suborders, mainly on the basis of the characteristics that seemed to produce classes having the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUPS: Suborders are separated into great groups on basis of uniformity in the kinds and sequence of major soil horizons and features. The horizons used to make separations are those in which clay, iron, or humus have accumulated or those that contain a pan that interferes with the growth of roots or the movement of water. The features used are the self-mulching properties of clays, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium), and the like. The great group is not shown separately in table 8, because it is the last word in the name of the subgroup.

SUBGROUPS: Great groups are subdivided into subgroups, one representing the central (typic) segment of

TABLE 8.—*Classification of soil series* [1]

Series	Family	Subgroup	Order
Absher	Fine, montmorillonitic	Borollic Natrargids	Aridisols.
Amor	Fine-loamy, mixed	Typic Haploborolls	Mollisols.
Arnegard	Fine-loamy, mixed	Pachic Haploborolls	Mollisols.
Belfield	Fine, montmorillonitic	Glossic Natriborolls	Mollisols.
Boxwell	Fine-loamy, mixed	Aridic Haploborolls	Mollisols.
Brandenburg	Loamy-skeletal, mixed, calcareous, frigid	Lithic Ustorthents	Entisols.
Cabba	Loamy, mixed, calcareous, frigid, shallow	Typic Ustorthents	Entisols.
Cabbart	Loamy, mixed, calcareous, frigid, shallow	Ustic Torriorthents	Entisols.
Chama	Fine-silty, mixed	Typic Haploborolls	Mollisols.
Chanta	Fine-loamy over sandy or sandy-skeletal, mixed	Aridic Haploborolls	Mollisols.
Cherry	Fine-silty, mixed, frigid	Typic Ustochrepts	Inceptisols.
Daglum	Fine, montmorillonitic	Typic Natriborolls	Mollisols.
Desart	Coarse-loamy, mixed	Typic Natriborolls	Mollisols.
Dilts	Clayey, montmorillonitic, acid, frigid, shallow	Ustic Torriorthents	Entisols.
Ekalaka	Coarse-loamy, mixed	Typic Natriborolls	Mollisols.
Flasher	Mixed, frigid, shallow	Typic Ustipsamments	Entisols.
Fleak	Mixed, frigid, shallow	Ustic Torripsamments	Entisols.
Glendive	Coarse-loamy, mixed, calcareous, frigid	Ustic Torrifluvents	Entisols.
Grail	Fine, montmorillonitic	Pachic Argiborolls	Mollisols.
Hanly	Sandy, mixed, frigid	Ustic Torrifluvents	Entisols.
Havre	Fine-loamy, mixed, calcareous, frigid	Ustic Torrifluvents	Entisols.
Heil	Fine, montmorillonitic, frigid	Typic Natraquolls	Mollisols.
Korchea	Fine-loamy, mixed, calcareous, frigid	Mollic Ustifluvents	Entisols.
Kremlin	Fine-loamy, mixed	Aridic Haploborolls	Mollisols.
Ladner	Coarse-loamy, mixed	Borollic Natrargids	Aridosils.
Lawther	Fine, montmorillonitic	Vertic Haploborolls	Mollisols.
Lefor	Fine-loamy, mixed	Typic Argiborolls	Mollisols.
Lehr	Fine-loamy over sandy or sandy-skeletal, mixed	Typic Haploborolls	Mollisols.
Lisam	Clayey, montmorillonitic, nonacid, frigid, shallow.	Ustic Torriorthents	Entisols.
Manning	Coarse-loamy over sandy or sandy-skeletal, mixed.	Typic Haploborolls	Mollisols.
Marmarth	Fine-loamy, mixed	Aridic Argiborolls	Mollisols.
McKenzie	Fine, montmorillonitic, calcareous, frigid	Typic Haplaquepts	Inceptisols.
Moreau	Fine, montmorillonitic	Typic Haploborolls	Mollisols.
Morton	Fine-silty, mixed	Typic Argiborolls	Mollisols.
Oburn	Fine, mixed	Borollic Natrargids	Aridols.
Parshall	Coarse-loamy, mixed	Pachic Haploborolls	Mollisols.
Patent	Fine-loamy, mixed, calcareous, frigid	Ustic Torriorthents	Entisols.
Reeder	Fine-loamy, mixed	Typic Argiborolls	Mollisols.
Regan	Fine-silty, frigid	Typic Calciaquolls	Mollisols.
Regent	Fine, montmorillonitic	Typic Argiborolls	Mollisols.
Rhame	Coarse-loamy, mixed	Aridic Haploborolls	Mollisols.
Rhoades	Fine, montmorillonitic	Leptic Natriborolls	Mollisols.
Savage	Fine, montmorillonitic	Typic Argiborolls	Mollisols.
Searing	Fine-loamy, mixed	Typic Haploborolls	Mollisols.
Sham	Coarse-loamy, mixed, calcareous, frigid	Ustic Torriorthents	Entisols.
Shambo	Fine-loamy, mixed	Typic Haploborolls	Mollisols.
Stady	Fine-loamy over sandy or sandy-skeletal, mixed	Typic Haploborolls	Mollisols.
Straw	Fine-loamy, mixed	Cumulic Haploborolls	Mollisols.
Tally	Coarse-loamy, mixed	Typic Haploborolls	Mollisols.
Telfer	Sandy, mixed	Entic Haploborolls	Mollisols.
Toby	Coarse-loamy, mixed	Borollic Camborthids	Mollisols.
Tusler	Mixed, frigid	Ustic Torripsamments	Entisols.
Vebar	Coarse-loamy, mixed	Typic Haploborolls	Mollisols.
Velva	Coarse-loamy, mixed	Fluventic Haploborolls	Mollisols.
Wabek	Sandy-skeletal, mixed	Entic Haploborolls	Mollisols.
Watrous	Fine-loamy, mixed	Typic Argiborolls	Mollisols.
Wayden	Clayey, montmorillonitic, calcareous, frigid, shallow.	Typic Ustorthents	Entisols.
Wolf Point	Fine, montmorillonitic, calcareous, frigid	Ustertic Torrifluvents	Entisols.
Yawdim	Clayey, mixed, calcareous, frigid, shallow	Ustic Torriorthents	Entisols.
Zeona	Mixed, frigid	Ustic Torripsamments	Entisols.

[1] Classification as of July 1972.

the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the great group.

FAMILIES: Families are separated within a subgroup mainly on the basis of properties important to the growth of plants or behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

SERIES: The series has the narrowest range of characteristics of the categories in the classification system and is explained in the section "How This Survey Was Made."

General Nature of the County

This section briefly discusses the history and development of Bowman County. It also provides information concerning the climate, physiography, relief, and drainage of the county.

History and Development

Prior to 1907 Bowman County was used for grazing by large ranching enterprises. Before the area was settled, wild animals, such as buffalo, deer, and antelope, roamed the prairie. When the first settlers came into the area they brought large herds of cattle and sheep from Texas, Missouri, and other older range territories. With the establishment of a railroad in 1907, a great influx of people came from Minnesota, Wisconsin, and other eastern states to establish homesteads and to buy cheap land that had originally been given to the railroads in the form of grants. These grants were then turned over to land companies and speculators for resale. The ranchers were pushed westward, and many left the territory. Some, however, remained and leased the waterholes and grazed their livestock on the grasslands around them.

In 1920 about 800 farmers were in Bowman County. Many of them were replacements who came after the first settlers had lost their land. The newer settlers brought considerable capital to help establish homes and farming enterprises. Those who operated a livestock and grain system were the most successful.

In the 1920's and 1930's many farmers and ranchers who had livestock enterprises changed to sheep, especially in the western and southern parts of the county. The soils and climatic conditions made grain farming a risky venture. During World War II, above-normal rainfall, the absence of cropping restrictions, and the high prices for wheat resulted in a rush to dispose of livestock and to raise wheat for the main cash crop. This condition prevails, and only a few large flocks and a few small farms are in the western and southern parts of the county.

During the late 1940's and early 1950's the farmers once again began raising livestock to stabilize their income, but they raised cattle. Although the cattle population had always been considerable in the county, the cattle were not of the best quality. Through the efforts of several livestock men who pioneered the purebred industry and livestock organizations, the herds have been very much improved and are now either purebreds or top-quality grades.

The eastern part of the county, where the soils are well suited to small grains, has always had a large number of small farm herds to supplement the income of the operations.

Through good years and bad years, the diversified livestock-grain operator has been the most successful. Often the small grain operator has failed in business because of adverse weather conditions, whereas the livestock and small grain operator has been able to stay in business or to improve his business through proper land use and good farming methods.

In 1940 about 577 farms were operated in the county, and the average size was 1,157 acres. In 1950 there were 545 farms, and the average size was 1,253 acres. In 1965 there were 421 farms, and the average size was 1,790 acres. Of the farms that year, full owners operated 125, part owners operated 251, and all tenants operated 45. Most farms are mechanized.

Providing transportation and access to markets, both inside and outside the county, are two Federal highways that intersect at Bowman: U.S. Highway No. 85, north and south, and U.S. Highway No. 12, east and west. These highways and State Route No. 67, which extends north from Scranton, North Dakota, provide a good network of hard-surfaced primary roads. Improved gravel and bituminous roads provide access to most farms and ranches. A main line of the Chicago, Milwaukee, St. Paul, and Pacific Railroad parallels U.S. Highway No. 12 across the county and provides freight service to points east and west.

Climate [8]

The climate of Bowman County is continental, and temperature changes are frequent and rapid throughout the year. The summers are warm, and the winters are cold (table 9). The days are 21 to 30 degrees warmer than the nights. Common temperature differences in a single month commonly vary from 51 to 70 degrees. Climatological data applicable to Bowman County are given in tables 9, 10, and 11.

Air movement from the Pacific Ocean is restricted by mountains, but is unrestricted from the north, east, and south. The average precipitation is approximately 1 inch less than that needed for good plant growth in June, 3½ inches less than that needed in July, and 3 inches less than that needed in August. In contrast, these are the months when the temperature is most favorable for plant growth. Potential evapotranspiration is about twice the average precipitation (fig. 13). Months and years of drought are common. Most farmers use summer fallow on loamy and clayey soils to store moisture and to reduce the effects of drought.

Hailstorms may occur at a particular site two to three times a year, and occasionally they severely damage crops

[8] By H. G. STOMMEL, climatologist for North Dakota, National Weather Service, U.S. Department of Commerce.

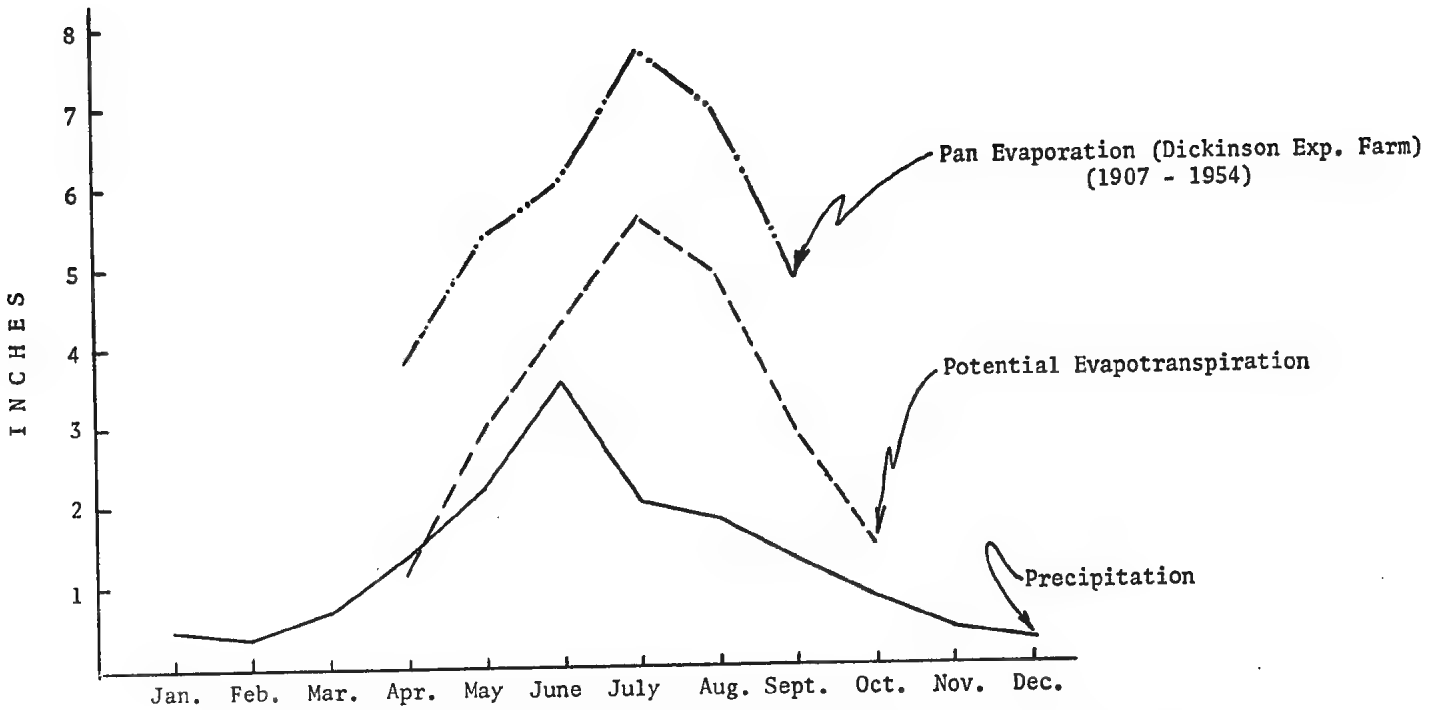

***Figure 13.*—Precipitation, pan evaporation, and potential evapotranspiration in Bowman County.**

TABLE 9.—*Precipitation intensity*

Period	Amount expected to occur about—		
	One year in 2	One year in 10	One year in 100
	In.	*In.*	*In.*
30 minutes	0. 80	1. 30	2. 05
1 hour	1. 00	1. 65	2. 60
2 hours	1. 15	1. 90	3. 00
3 hours	1. 20	2. 10	3. 10
6 hours	1. 40	2. 30	3. 50
12 hours	1. 70	2. 70	4. 00
24 hours	1. 80	3. 00	4. 50

and buildings. Five tornadoes have been reported in Bowman County in 51 years.

About 30 thunderstorms pass over Bowman County each year. Severe blizzards having winds of 60 miles per hour or more, accompanied by below-zero temperatures, occur about 1 year in 3.

Warm, dry winds, called chinooks, occur when air descends from the Rocky Mountains and blows from the southwest or west. These winds are particularly noticeable in winter when they melt the snow and allow cattle to graze winter pasture.

Precipitation is highly variable, but averages 15 inches per year. Seventy percent of the rain falls from May through September, and 50 percent falls during June, July, and August, the best months for growing crops.

Annual precipitation ranged from 7 inches in 1919 to 24 inches in 1941. June generally is the wettest month, but in 1915, July had 7.55 inches of rain. Precipitation intensities of 1.0 inch per hour, 1.4 inches in 6 hours, or 1.8 inches in 24 hours can be expected 1 year in 2 (table 9).

About 26 inches of snow falls annually. In January 21 days have a snow cover of 1 inch or more. Snow has been recorded in all months except June, July, and August (table 10).

The average annual temperature is 42.9° F. In December, January, and February the average monthly temperature is 17.9°. Minimum temperatures fall below 0° on 36 days of the year, and on some days the highest temperature is below 0°. About half of the days in winter have maximum temperatures above 32°. The average maximum temperature for June, July, and August is 82°. An average year has 26 days with temperatures of 90° or

TABLE 10.—*Temperature and precipitation*

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average total	One year in 10 will have—		Average number of days with snow cover of 1 inch or more	Average depth of snow on days with snow cover
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—		
	°F.	°F.	°F.	°F.	Inches	Inches	Inches		Inches
January	24.9	2.9	47	−23	0.46	0.1	1.1	21	4
February	29.7	7.8	51	−16	.39	.1	.8	17	5
March	38.2	16.5	60	−8	.67	.1	1.3	15	5
April	55.1	29.9	74	15	1.36	.4	2.3	2	3
May	66.9	41.2	85	29	2.17	.8	4.4	(1)	3
June	75.6	49.9	91	40	3.51	1.2	5.8	0	0
July	85.8	56.1	98	46	2.01	.7	4.1	0	0
August	84.1	53.7	97	43	1.80	.7	2.9	0	0
September	72.3	42.9	90	31	1.27	.2	2.7	(1)	1
October	59.9	33.2	80	21	.81	.1	1.8	1	4
November	41.8	19.4	64	2	.42	.1	.9	7	4
December	31.6	10.6	50	−16	.27	.1	.6	14	3
Year	55.5	30.3	[2] 101	[3] −29	15.14	10.3	19.2	77	4

[1] Less than half a day.

[2] Average annual highest temperature.

[3] Average annual lowest temperature.

TABLE 11.—*Probability of last low temperatures in spring and first in fall*

Probability	Dates for given probability and temperature				
	32° F. or lower	28° F. or lower	24° F. or lower	20° F. or lower	16° F. or lower
Spring:					
10 percent later than	June 2	May 19	May 14	May 4	April 30
25 percent later than	May 26	May 12	May 6	April 27	April 22
50 percent later than	May 19	May 5	April 28	April 18	April 13
75 percent later than	May 12	April 28	April 20	April 10	April 4
90 percent later than	May 5	April 21	April 12	April 2	March 27
Fall:					
10 percent earlier than	September 8	September 16	September 25	October 2	October 10
25 percent earlier than	September 14	September 22	October 3	October 10	October 18
50 percent earlier than	September 20	September 29	October 11	October 19	October 27
75 percent earlier than	September 26	October 6	October 19	October 28	November 5
90 percent earlier than	October 2	October 12	October 27	November 5	November 13

more. The coolest summer on record has nine such days. In 1936, 54 days had a temperature of 90° or more.

The maximum possible sunshine averages 45 percent in winter and 80 percent in summer. The average relative humidity is 75 percent in winter and ranges from 80 percent in the morning to 45 percent in the afternoon in summer.

The average windspeed is 11 miles per hour, but the maximum often is several times this speed. These winds cause erosion where certain soils are not protected by vegetation or cloddy tillage. The prevailing wind is from the west-northwest.

The length of the growing season is the number of days between the last frost in spring and the first frost in fall. The frost-free growing season averages 124 days (table 11).

Physiography, Relief, and Drainage

Bowman County is located on the gently sloping plain known as the Missouri Plateau. It is on the part of the plateau that was not glaciated. The land surface rises gradually to the west and is about 3,000 feet above sea level. The established elevations above sea level for the three largest towns in the county are Scranton, 2,772 feet; Bowman, 2,872 feet; and Rhame, 3,182 feet.

The eastern two-thirds of the county is a gently sloping plain that is level in places (fig. 14). The plain is

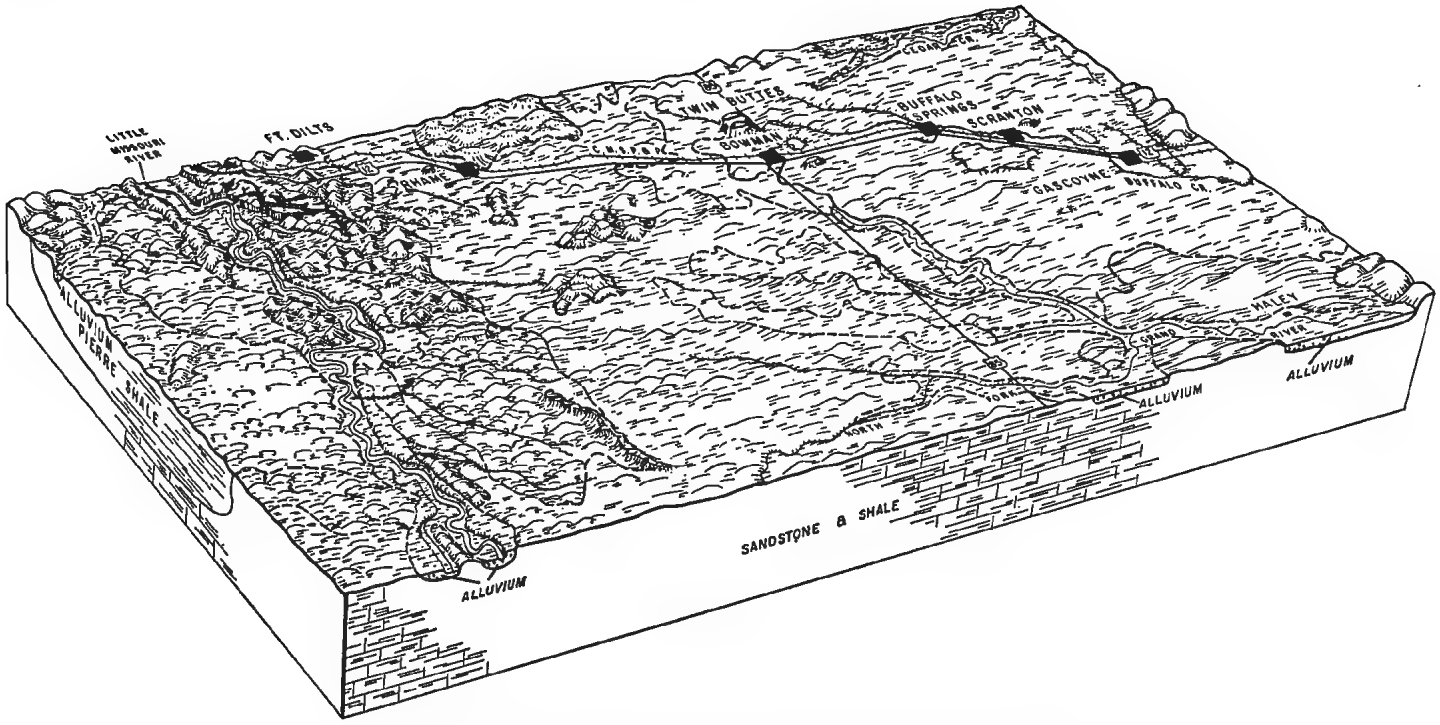

***Figure 14.*—General landscape and underlying material of Bowman County.**

characterized by buttes and hills that indicate that at one time an even higher surface existed. Some of these locally well-known features are Post Office, Sunset, Talbert, and Twin Buttes and the Medicine Pole Hills. The Medicine Pole Hills and Twin Buttes have flat tops, but Post Office, Sunset, and Talbert Buttes have somewhat rounded tops. Another example of these heights is the scoria-covered hills in the Rhame vicinity.

To the south, along the South Dakota line, the North Fork of the Grand River occupies a shallow valley. In the western third of the county the gently sloping plain intertongues with the Badlands or one of the broad terraces that are 100 to 150 feet above the Little Missouri River. Some of these terraces have extensive gravel deposits. There is little or no relationship between these terrace deposits and present-day drainage. The Badlands are on parts of a belt on both sides of the Little Missouri River, Tributaries, large and small, have severely dissected this area until the relief is a series of ridges, pinnacles, domes, cones of shale and sandstone, and valleys of vertical cliffs. The Little Missouri River meanders through a narrow valley bordered by terraces varying in area and texture.

The western part of the county has high and low terraces extending along Box Elder Creek to the south. Northward from the terraces, the surface is gently sloping to rolling and grades to the low and more round hills of the Dilts-Lisam-Shale outcrop soil association. Northward the land is gently sloping to hilly in places and grades to the narrow valley of Little Beaver Creek near the northwest corner of the county. In the northwest corner the land is hilly to steep in places.

Bowman County has seven main watersheds. The Little Missouri River watershed drains about 242,000 acres in the western part of the county. The Grand River watershed, including the drainage of Spring and Lightning Creeks, drains about 298,000 acres in the central, southern, and southeastern parts of the county. In the northeastern part of the county, Cedar Creek drains about 57,000 acres. Lying between the Cedar Creek and Grand River watersheds is the Buffalo Creek drainage, which eventually empties into the Grand River in South Dakota. It drains about 80,000 acres. Deep Creek drains about 28,000 acres north of Bowman and Rhame and eventually empties into the Little Missouri River in Slope County to the north. The Little Beaver Creek watershed drains about 22,000 acres in the northwest part of the county. In the very southwest part of the county, the Box Elder Creek watershed drains about 11,000 acres. Both the Box Elder and Little Beaver Creeks empty into the Little Missouri River.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkinality (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is low from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Badlands. Areas of rough, irregular, land where most of the surface is occupied by ridges, gullies, and deep channels. Land hard to traverse.

Base saturation. The degree to which material that has base-exchange properties is saturated with exchangeable cations other than hydrogen, expressed as a percentage of the cation-exchange capacity.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visably when treated with cold, dilute hydrochloric acid.

Channery soil. A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Claypan. A compact, slowly permeable soil horizon that contains more clay than the horizon above and below it. A claypan is commonly hard when dry and plastic or stiff when wet.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and have mottling in the lower B and the C horizons.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surfaces by wind (sandblast), running water, and other geological agents.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors such as light, moisture, temperature, and the physical condition of the soil are favorable.

Gleyed soil. A soil in which waterlogging and lack of oxygen have caused the material in one or more horizons to be neutral gray in color. The term "gleyed" is applied to soil horizons with yellow and gray mottling caused by intermittent waterlogging.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few*, *common*, and *many;* size—*fine*, *medium*, and *coarse;* and contrast—*faint*, *distinct*, and *prominent*. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Paralithic contact. A boundary between soil and continuous, coherent underlying material that has a hardness of less than 3 (Mohs scale). When moist, the underlying material can be dug with a spade and chunks disperse in water with 15 hours of shaking.

Parent material. Disintegrated and partly weather rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Phase, soil. A subdivision of a soil, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects its management but not its behavior in the natural landscape.

pH value. A numerical means for designating acidity and alkalinity in soils. A pH value of 7.0 indicates precise neutrality; a higher value, alkalinity; and a lower value, acidity.

Porcellanite. Red baked shale or clinker beds. Locally called *scoria.*

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid reaction; and alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline.	9.1 and higher

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular. Structureless* soils are either *single grain* (each grain by itself, as in dune sand) or *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse", "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit or a range site, read the introduction to the section it is in for general information about its management. Windbreak suitability groups are described on pages 94 and 95. Other information is given in tables as follows:

Acreage and extent, table 1, page 10.
Estimated yields, table 2, page 88.
Wildlife interpretations, table 4, page 96.

Engineering uses of the soils, tables 5, 6, and 7, pages 98 through 127.

Map symbol	Mapping unit	Page	Capability unit		Range site		Windbreak suitability group
			Symbol	Page	Name	Page	Number
Ad	Alluvial land, saline	12	VIs-SS	85	Saline Lowland	91	10
Ae	Alluvial land, strongly saline	13	VIs-SS	85	Saline Lowland	91	10
Af	Alluvial land, wet	13	Vw-WL	84	Wetland	90	10
Ag	Amor loam, sloping	13	IIIe-6	80	Silty	91	3
AlD	Amor-Cabba loams, strongly sloping	14	IVe-6	83	------	--	--
	Amor part	--	-----	--	Silty	91	3
	Cabba part	--	-----	--	Shallow	91	10
AmA	Amor-Shambo loams, nearly level	14	IIc-6	79	Silty	91	3
AmB	Amor-Shambo loams, gently sloping	14	IIe-6	78	Silty	91	3
ArA	Arnegard loam, nearly level	15	IIc-6	79	Overflow	92	1
ArB	Arnegard loam, gently sloping	15	IIe-6	78	Silty	91	1
Ba	Badland	15	VIIs	86	(1/)	--	10
Bb	Barren badland	16	VIIIe	87	(1/)	--	10
BeA	Belfield silt loam, nearly level	17	IIIs-P	81	Clayey	91	4
BeB	Belfield silt loam, gently sloping	17	IIIe-P	80	Clayey	91	4
BfA	Belfield silty clay loam, nearly level	17	IIIs-P	81	Clayey	91	4
BfB	Belfield silty clay loam, gently sloping	17	IIIe-P	80	Clayey	91	4
Bh	Blown-out land	18	VIe-TSa	85	Thin Sands	93	10
Bk	Blown-out land-Ladner-Ekalaka complex	18	VIIs-Cp	86	------	--	--
	Blown-out land	--	-----	--	(1/)	--	10
	Ladner part	--	-----	--	Claypan	91	9
	Ekalaka part	--	-----	--	Sandy	91	9
BoC	Boxwell loam, sloping	18	IVe-6	83	Silty	91	3
BrD	Boxwell-Cabbart loams, strongly sloping	19	VIe-Si	84	------	--	--
	Boxwell part	--	-----	--	Silty	91	3
	Cabbart part	--	-----	--	Shallow	91	10
BtB	Boxwell-Kremlin loams, gently sloping	19	IIIe-6	80	Silty	91	3
BuD	Brandenburg-Cabba complex, hilly	19	VIIs-VS	86	------	--	10
	Brandenburg part	--	-----	--	Very Shallow	92	--
	Cabba part	--	-----	--	Shallow	91	--
CaC	Cabba complex, sloping	21	IVe-4L	83	Shallow	91	8
CaE	Cabba complex, steep	21	VIe-Sw	85	Shallow	91	10
CbC	Cabba-Amor loams, sloping	21	IVe-4L	83	------	--	--
	Cabba part	--	-----	--	Shallow	91	8
	Amor part	--	-----	--	Silty	91	3
CbD	Cabba-Amor loams, hilly	21	VIe-Sw	85	------	--	--
	Cabba part	--	-----	--	Shallow	91	10
	Amor part	--	-----	--	Silty	91	3
Cd	Cabba-Wayden-Shale outcrop complex	21	VIIe-Sw	86	------	--	10
	Shale outcrop	--	-----	--	(1/)	--	--
	Cabba part	--	-----	--	Shallow	91	--
	Wayden part	--	-----	--	Shallow	91	--
Ce	Cabba and Wayden stony soils	22	VIIe-Sw	86	Shallow	91	10
CgC	Cabbart-Boxwell loams, sloping	23	IVe-4L	83	------	--	--
	Cabbart part	--	-----	--	Shallow	91	8
	Boxwell part	--	-----	--	Silty	91	3

Map symbol	Mapping unit	Page	Capability unit		Range site		Windbreak suitability group
			Symbol	Page	Name	Page	Number
CgD	Cabbart-Boxwell loams, hilly	23	VIe-Sw	85	------	--	--
	Cabbart part	--	-----	--	Shallow	91	10
	Boxwell part	--	-----	--	Silty	91	3
ChE	Cabbart complex, steep	23	VIe-Sw	85	Shallow	91	10
Ck	Cabbart-Yawdim-Shale outcrop complex	23	VIIe-Sw	86	------	--	10
	Shale outcrop	--	-----	--	(1/)	--	--
	Cabbart part	--	-----	--	Shallow	91	--
	Yawdim part	--	-----	--	Shallow	91	--
CmA	Chama and Morton silty clay loams, nearly level	24	IIe-6	79	Silty	91	--
	Chama part	--	-----	--	------	--	8
	Morton part	--	-----	--	------	--	3
CmB	Chama and Morton silty clay loams, gently sloping	24	IIe-6	78	Silty	91	--
	Chama part	--	-----	--	------	--	8
	Morton part	--	-----	--	------	--	3
CnC	Chama, Morton, and Cabba silty clay loams, sloping	25	IIIe-6	80	------	--	--
	Chama part	--	-----	--	Silty	91	8
	Morton part	--	-----	--	Silty	91	3
	Cabba part	--	-----	--	Shallow	91	8
CoA	Chanta loam, nearly level	25	IIIs-5	81	Silty	91	6
CoB	Chanta loam, gently sloping	25	IIIes-5	81	Silty	91	6
CrA	Cherry clay loam, nearly level	26	IIc-6	79	Silty	91	3
CrB	Cherry clay loam, gently sloping	26	IIIe-6	80	Silty	91	3
CrC	Cherry clay loam, sloping	26	IIIe-6	80	Silty	91	3
DaB	Daglum fine sandy loam, gently sloping	28	IVe-3P	82	Claypan	91	9
DdA	Daglum-Rhoades loams, nearly level	28	IVs-P	84	------	--	9
	Daglum part	--	-----	--	Claypan	91	--
	Rhoades part	--	-----	--	Thin Claypan	92	--
DlC	Dilts and Lisam clays, rolling	29	VIs-SwC	85	Shallow Clay	92	10
DlE	Dilts and Lisam clays, steep	29	VIIs-SwC	86	Shallow Clay	92	10
EdB	Ekalaka-Desart fine sandy loams, gently undulating	30	IIIe-3P	79	Sandy	91	--
	Ekalaka part	--	-----	--	------	--	9
	Desart part	--	-----	--	------	--	4
ElC	Ekalaka-Ladner complex, rolling	31	IVe-3P	82	------	--	9
	Ekalaka part	--	-----	--	Sandy	91	--
	Ladner part	--	-----	--	Claypan	91	--
EmB	Ekalaka-Zeona-Ladner loamy fine sands, gently sloping	31	IVe-2P	82	------	--	--
	Ekalaka part	--	-----	--	Sandy	91	9
	Zeona part	--	-----	--	Thin Sands	93	10
	Ladner part	--	-----	--	Claypan	91	9
FeE	Flasher complex, steep	32	VIe-Sw	85	Shallow	91	10
FhD	Flasher-Vebar complex, hilly	32	VIe-Sw	85	------	--	--
	Flasher part	--	-----	--	Shallow	91	10
	Vebar part	--	-----	--	Sandy	91	7
Fm	Flasher and Vebar very stony soils	33	VIIs-Sy	86	------	--	10
	Flasher part	--	-----	--	Shallow	91	--
	Vebar part	--	-----	--	Sandy	91	--
FnD	Fleak-Rhame complex, hilly	33	VIe-Sw	85	------	--	--
	Fleak part	--	-----	--	Shallow	91	10
	Rhame part	--	-----	--	Sandy	91	7
FoE	Fleak rocky complex, steep	34	VIIe-Sw	86	Shallow	91	10

Map symbol	Mapping unit	Page	Capability unit		Range site		Windbreak suitability group
			Symbol	Page	Name	Page	Number
FtE	Fleak-Tusler complex, steep	34	VIe-Sw	85	------	--	10
	Fleak part	--	-----	--	Shallow	91	--
	Tusler part	--	-----	--	Thin Sands	93	--
GdA	Glendive fine sandy loam, nearly level	35	IIIe-3	79	Overflow	92	1
GdB	Glendive fine sandy loam, undulating	35	IIIe-3	79	Sandy	91	1
GeA	Grail silt loam, nearly level	35	IIc-6	79	Overflow	92	1
GeB	Grail silt loam, gently sloping	36	IIe-6	78	Silty	91	1
GlA	Grail silty clay loam, nearly level	36	IIc-7	79	Overflow	92	1
GlB	Grail silty clay loam, gently sloping	36	IIe-7	79	Silty	91	1
Gm	Grail soils, saline	36	IIIws-4	82	Saline Lowland	91	10
GoA	Grail-Rhoades silty clay loams, nearly level	36	IIIs-P	81	------	--	--
	Grail part	--	-----	--	Overflow	92	1
	Rhoades part	--	-----	--	Thin Claypan	92	9
GoB	Grail-Rhoades silty clay loams, gently sloping	37	IIIe-P	80	------	--	--
	Grail part	--	-----	--	Silty	91	1
	Rhoades part	--	-----	--	Thin Claypan	92	9
Gp	Gravel pit	37	VIIIs	87	(1/)	--	10
Ha	Hanly loamy fine sand	37	VIe-TSa	85	Thin Sands	93	7
Hc	Hanly soils, channeled	38	VIe-Ov	84	Overflow	92	7
He	Havre loam	38	IIe-4L	78	Overflow	92	1
Hm	Havre clay loam	38	IIe-4L	78	Overflow	92	1
Kc	Korchea loam	40	IIc-6	79	Overflow	92	1
Ke	Korchea clay loam, wet variant	40	VIw-Ov	85	Overflow	92	10
Kh	Korchea-Havre complex	40	IIc-6	79	Overflow	--	1
Km	Korchea-Straw complex	40	IIc-6	79	Overflow	92	1
Kn	Korchea and Havre soils, channeled	40	VIe-Ov	84	Overflow	92	1
Ko	Korchea and Straw soils, channeled	41	VIe-Ov	84	Overflow	92	1
KrA	Kremlin loam, nearly level	41	IIc-6	79	Silty	91	3
KrB	Kremlin loam, gently sloping	41	IIe-6	78	Silty	91	3
KsA	Kremlin-Belfield-Rhoades complex, nearly level	41	IIIs-P	81	------	--	--
	Kremlin part	--	-----	--	Silty	91	3
	Belfield part	--	-----	--	Clayey	91	4
	Rhoades part	--	-----	--	Thin Claypan	92	4
La	Lawther silty clay	43	IIs-4	79	Clayey	91	4
Lc	Lawther-Rhoades silty clays	43	IIIs-P	81	------	--	--
	Lawther part	--	-----	--	Clayey	91	4
	Rhoades part	--	-----	--	Thin Claypan	92	9
LeB	Lefor-Vebar fine sandy loams, gently sloping	44	IIIe-3M	79	Sandy	91	5
LeC	Lefor-Vebar fine sandy loams, sloping	44	IVe-3	82	Sandy	91	5
LmC	Lehr, Manning, and Wabek soils, sloping	45	IVes-3	83	------	--	--
	Lehr part	--	-----	--	Shallow to Gravel	92	6
	Manning part	--	-----	--	Sandy	91	6
	Wabek part	--	-----	--	Very Shallow	92	10
MaA	Manning fine sandy loam, nearly level	46	IIIes-3	81	Sandy	91	6
MaB	Manning fine sandy loam, gently sloping	46	IIIes-3	81	Sandy	91	6
MeB	Marmarth loam, gently sloping	47	IIIe-6	80	Silty	91	3
MgC	Marmarth-Cabbart complex, sloping	47	IVe-6	83	------	--	--
	Marmarth part	--	-----	--	Silty	91	3
	Cabbart part	--	-----	--	Shallow	91	8

GUIDE TO MAPPING UNITS--Continued

Map symbol	Mapping unit	Page	Capability unit		Range site		Windbreak suitability group
			Symbol	Page	Name	Page	Number
MhB	Marmarth-Rhame fine sandy loams, gently sloping	47	IIIe-3M	79	------	--	--
	Marmarth part	--	-----	--	Silty	91	3
	Rhame part	--	-----	--	Sandy	91	5
MhC	Marmarth-Rhame fine sandy loams, sloping	47	IVe-3	82	------	--	--
	Marmarth part	--	-----	--	Silty	91	3
	Rhame part	--	-----	--	Sandy	91	5
MkA	Marmarth-Rhoades complex, nearly level	48	IIIs-P	81	------	--	--
	Marmarth part	--	-----	--	Silty	91	3
	Rhoades part	--	-----	--	Thin Claypan	92	9
MkB	Marmarth-Rhoades complex, gently sloping	48	IIIe-P	80	------	--	--
	Marmarth part	--	-----	--	Silty	91	3
	Rhoades part	--	-----	--	Thin Claypan	92	9
MkC	Marmarth-Rhoades complex, sloping	48	IVe-P	83	------	--	--
	Marmarth part	--	-----	--	Silty	91	3
	Rhoades part	--	-----	--	Thin Claypan	92	9
Mm	Marmarth and Boxwell very stony loams	49	VIIs-Si	86	Silty	91	10
Mn	McKenzie silty clay	49	VIs-CD	85	Closed Depression	93	10
Mo	McKenzie and Heil silty clays	49	-----	--	Closed Depression	93	10
	McKenzie part	--	VIs-CD	85	------	--	--
	Heil part	--	IVsw	84	------	--	--
Mp	Mine dumps	50	VIIIs	87	(1/)	--	10
MrA	Moreau silty clay, nearly level	51	IIIes	80	Clayey	91	4
MrB	Moreau silty clay, gently sloping	51	IIIes	80	Clayey	91	4
MwC	Moreau-Wayden silty clays, sloping	51	IVes-4	83	------	--	--
	Moreau part	--	-----	--	Clayey	91	4
	Wayden part	--	-----	--	Shallow	91	8
Ob	Oburn complex	52	VIs-TC	85	Thin Claypan	92	9
PaA	Parshall fine sandy loam, nearly level	53	IIIe-3	79	Sandy	91	1
PeB	Patent loam, gently sloping	53	IIIe-4L	80	Silty	91	3
PeC	Patent loam, sloping	54	VIe-Si	84	Silty	91	3
RcC	Reeder-Cabba loams, sloping	54	IIIe-6	80	------	--	--
	Reeder part	--	-----	--	Silty	91	3
	Cabba part	--	-----	--	Shallow	91	8
RdA	Reeder-Rhoades complex, nearly level	55	IIIs-P	81	------	--	--
	Reeder part	--	-----	--	Silty	91	3
	Rhoades part	--	-----	--	Thin Claypan	92	9
RdB	Reeder-Rhoades complex, gently sloping	55	IIIe-P	80	------	--	--
	Reeder part	--	-----	--	Silty	91	3
	Rhoades part	--	-----	--	Thin Claypan	92	9
RdC	Reeder-Rhoades complex, sloping	55	IVe-P	83	------	--	--
	Reeder part	--	-----	--	Silty	91	3
	Rhoades part	--	-----	--	Thin Claypan	92	9
ReA	Reeder-Shambo loams, nearly level	55	IIc-6	79	Silty	91	3
ReB	Reeder-Shambo loams, gently sloping	56	IIe-6	78	Silty	91	3
Rf	Reeder and Amor very stony loams	56	VIIs-Si	86	Silty	91	10
Rg	Regan silt loam	57	IIIws-4	82	Wet Meadow	90	10
RhA	Regent silty clay loam, nearly level	57	IIc-7	79	Clayey	91	3
RhB	Regent silty clay loam, gently sloping	58	IIe-7	79	Clayey	91	3
RkC	Regent-Moreau silty clay loams, sloping	58	IIIe-7	80	Clayey	91	--
	Regent part	--	-----	--	------	--	3
	Moreau part	--	-----	--	------	--	4

Map symbol	Mapping unit	Page	Capability unit		Range site		Windbreak suitability group
			Symbol	Page	Name	Page	Number
R1B	Regent-Moreau-Rhoades complex, gently sloping	58	IIIe-P	80	------	--	--
	Regent part	--	-----	--	Clayey	91	3
	Moreau part	--	-----	--	Clayey	91	4
	Rhoades part	--	-----	--	Thin Claypan	92	9
RmA	Regent-Rhoades complex, nearly level	58	IIIs-P	81	------	--	--
	Regent part	--	-----	--	Clayey	91	3
	Rhoades part	--	-----	--	Thin Claypan	92	9
RnB	Rhame fine sandy loam, gently sloping	59	IIIe-3	79	Sandy	91	5
RoC	Rhame-Fleak fine sandy loams, sloping	59	IVe-3	82	------	--	--
	Rhame part	--	-----	--	Sandy	91	5
	Fleak part	--	-----	--	Shallow	91	10
RoD	Rhame-Fleak fine sandy loams, hilly	59	VIe-Sy	85	------	--	--
	Rhame part	--	-----	--	Sandy	91	7
	Fleak part	--	-----	--	Shallow	91	10
RrA	Rhoades-Absher complex, nearly level	60	VIs-TC	85	Thin Claypan	92	9
RrB	Rhoades-Absher complex, gently sloping	61	VIs-TC	85	Thin Claypan	92	9
Rt	Rhoades complex, terrace	61	VIs-TC	85	Thin Claypan	92	9
Rw	Riverwash	61	VIIIe	87	(1/)	--	10
SaA	Savage silty clay loam, nearly level	62	IIc-7	79	Clayey	91	3
ScA	Savage-Rhoades silty clay loams, nearly level	62	IIIs-P	81	------	--	--
	Savage part	--	-----	--	Clayey	91	3
	Rhoades part	--	-----	--	Thin Claypan	92	9
SeB	Searing loam, gently sloping	63	IIIes-5	81	Silty	91	6
SeC	Searing loam, sloping	63	IIIes-5	81	Silty	91	6
Sg	Sham soils and Gullied land	64	VIIs-Cp	86	------	--	--
	Sham part	--	-----	--	Claypan	91	10
	Gullied land	--	-----	--	(1/)	--	10
ShA	Shambo loam, nearly level	65	IIc-6	79	Silty	91	3
ShB	Shambo loam, gently sloping	65	IIe-6	78	Silty	91	3
SlA	Shambo-Arnegard loams, nearly level	65	IIc-6	79	------	--	--
	Shambo part	--	-----	--	Silty	91	3
	Arnegard part	--	-----	--	Overflow	92	1
SlB	Shambo-Arnegard loams, gently sloping	65	IIe-6	78	Silty	91	--
	Shambo part	--	-----	--	------	--	3
	Arnegard part	--	-----	--	------	--	1
SmA	Shambo-Belfield-Rhoades loams, nearly level	66	IIIs-P	81	------	--	--
	Shambo part	--	-----	--	Silty	91	3
	Belfield part	--	-----	--	Clayey	91	4
	Rhoades part	--	-----	--	Thin Claypan	92	9
SnA	Stady loam, nearly level	66	IIIs-5	81	Silty	91	6
SrB	Stady-Lehr loams, gently sloping	67	IIIes-5	81	------	--	6
	Stady part	--	-----	--	Silty	91	--
	Lehr part	--	-----	--	Shallow to Gravel	92	--
SsA	Stady-Shambo loams, nearly level	67	IIe-5	78	Silty	91	--
	Stady part	--	-----	--	------	--	6
	Shambo part	--	-----	--	------	--	3
TaB	Tally fine sandy loam, gently sloping	68	IIIe-3	79	Sandy	91	5
TaC	Tally fine sandy loam, sloping	68	IVe-3	82	Sandy	91	5
TdA	Tally-Parshall fine sandy loams, nearly level	68	IIIe-3	79	Sandy	91	--
	Tally part	--	-----	--	------	--	5
	Parshall part	--	-----	--	------	--	1
Te	Telfer loamy fine sand	69	IVe-2	82	Sands	91	7

Map symbol	Mapping unit	Page	Capability unit: Symbol	Capability unit: Page	Range site: Name	Range site: Page	Windbreak suitability group: Number
TfC	Telfer-Flasher loamy fine sands, sloping--	69	VIe-Sa	84	------	--	--
	Telfer part	--	-----	--	Sands	91	7
	Flasher part	--	-----	--	Shallow	91	10
ToA	Toby fine sandy loam, nearly level	70	IIIe-3	79	Sandy	91	5
ToB	Toby fine sandy loam, gently sloping	70	IIIe-3	79	Sandy	91	5
ToC	Toby fine sandy loam, sloping	70	IVe-3	82	Sandy	91	5
TrA	Toby loam, nearly level	70	IIe-5	78	Sandy	91	5
VfC	Vebar-Flasher fine sandy loam, sloping	71	IVe-3	82	------	--	--
	Vebar part	--	-----	--	Sandy	91	5
	Flasher part	--	-----	--	Shallow	91	10
VfD	Vebar-Flasher fine sandy loams, hilly	71	VIe-Sy	85	------	--	--
	Vebar part	--	-----	--	Sandy	91	5
	Flasher part	--	-----	--	Shallow	91	10
VtB	Vebar-Tally fine sandy loams, gently sloping	72	IIIe-3	79	Sandy	91	5
Vv	Velva fine sandy loam	72	IIIe-3	79	Overflow	92	1
Wa	Wabek complex	73	VIs-VS	86	Very Shallow	92	10
Wm	Watrous loam	74	IIIs-R	81	Silty	91	6
WoC	Wayden-Moreau complex, sloping	74	VIe-Sw	85	------	--	--
	Wayden part	--	-----	--	Shallow	91	8
	Moreau part	--	-----	--	Clayey	91	4
Wp	Wolf Point clay	75	IIs-4	79	Clayey	91	1
YaC	Yawdim silty clay, sloping	75	VIe-Sw	85	Shallow	91	8
Zd	Zeona fine sand, hummocky	76	VIe-TSa	85	Thin Sands	93	10
ZeC	Zeona fine sand, undulating	76	VIe-TSa	85	Thin Sands	93	10
ZfB	Zeona loamy fine sand, gently sloping	76	IVe-2	82	Thin Sands	93	10
ZtC	Zeona-Tusler loamy fine sands, sloping	76	VIe-TSa	85	Thin Sands	93	10

1/ Range site not assigned.

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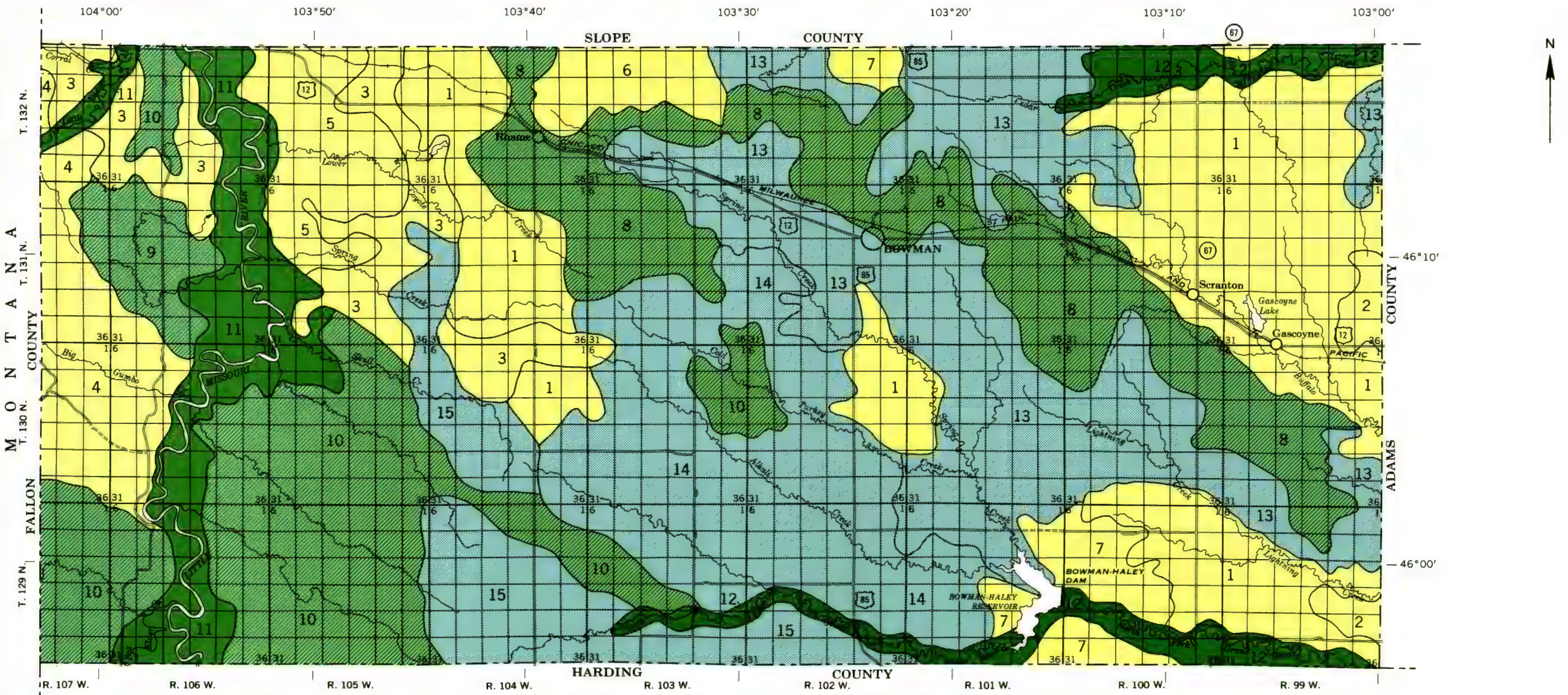


SOIL ASSOCIATIONS *

SOILS UNDERLAIN BY SOFT SHALE; ON UPLANDS

1 Amor-Reeder-Cabba association: Nearly level to strongly sloping, moderately deep and shallow, well-drained, loamy soils

2 Regent-Moreau-Cabba association: Nearly level to gently sloping, moderately deep and shallow, well-drained, loamy and clayey soils

3 Cabbart-Absher association: Hilly to steep, shallow and deep, moderately well drained and well drained, loamy soils and loamy soils that have a claypan

4 Dilts-Lisam-Shale outcrop association: Gently sloping to hilly, shallow, well-drained, clayey soils and shale outcrops

5 Cabbart-Badlands-Yawdim association: Steep to very steep, shallow, well-drained, loamy and clayey soils and badland

6 Reeder-Brandenburg-Cabba association: Gently sloping to strongly sloping, moderately deep and shallow, well-drained and excessively drained, loamy soils

7 Cabba-Amor-Chama association: Rolling to hilly, shallow and moderately deep, well-drained, loamy soils

SOILS UNDERLAIN BY SOFT SANDSTONE; ON UPLANDS

8 Vebar-Flasher association: Nearly level to gently undulating, moderately deep, well-drained and shallow, excessively drained, sandy and loamy soils

9 Rhame-Fleak association: Nearly level to gently undulating, moderately deep, well-drained, loamy soils, and shallow, excessively drained, sandy soils

10 Ekalaka-Rhame-Zeona association: Nearly level to gently undulating, deep and moderately deep, well-drained, loamy soils and loamy soils that have a claypan, and deep, excessively drained, sandy soils

SOILS ON TERRACES AND BOTTOM LANDS

11 Havre-Toby-Glendive association: Nearly level, deep, well-drained, loamy soils

12 Korchea-Straw association: Nearly level, deep, well drained and moderately well drained, loamy soils

SOILS THAT HAVE A CLAYPAN, UNDERLAIN BY SOFT SHALE; ON UPLANDS

13 Belfield-Rhoades-Amor association: Nearly level to gently sloping, deep and moderately deep, well drained and moderately well drained, loamy soils and loamy soils that have a claypan

14 Rhoades-Moreau association: Nearly level to gently sloping, deep and moderately deep, moderately well drained and well drained, loamy soils that have a claypan and clayey soils

15 Rhoades-Absher association: Nearly level to gently sloping, deep and moderately deep, well drained and moderately well drained, loamy soils that have a claypan

* The terms for textures used in the descriptive heading apply to the surface layer of the major soils.

Compiled 1973

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

BOWMAN COUNTY, NORTH DAKOTA

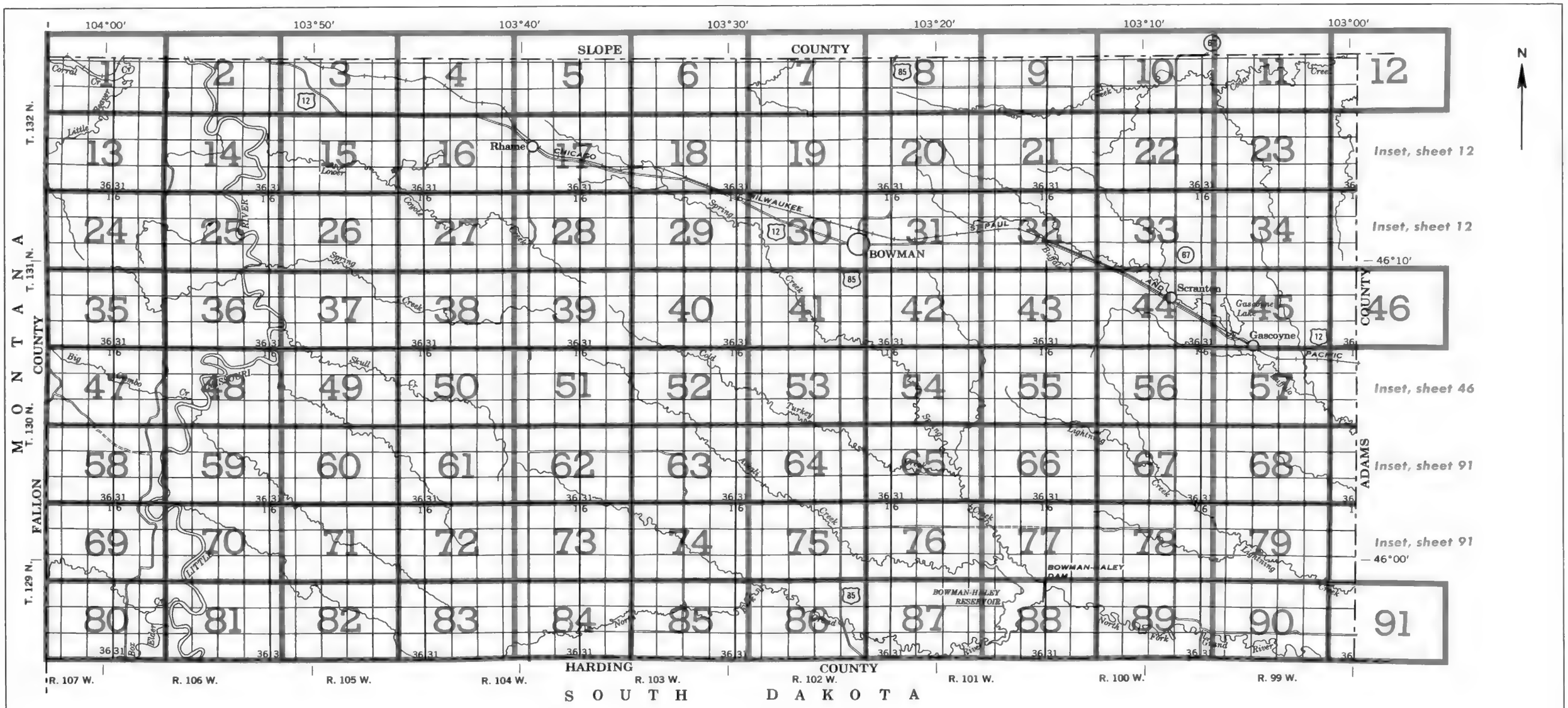
Scale 1:253,440

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS

BOWMAN COUNTY, NORTH DAKOTA

Scale 1:253,440

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

BOWMAN COUNTY, NORTH DAKOTA

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry
- Ford
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches

Lakes and ponds
- Perennial
- Intermittent

Spring

Marsh or swamp

Wet spot

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Prominent peak

Depressions

	Large	Small
Crossable with tillage implements		
Not crossable with tillage implements		
Contains water most of the time		

SOIL SURVEY DATA

- Soil boundary and symbol
- Gravel
- Stoniness
  - Stony
  - Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully
- Clay butte
- Saline spot
- Small hill of sandy soils
- Small hill of silty or clayey soils

SOIL LEGEND

The first letter, always a capital, is the initial one of the soil name. A second capital letter, A, B, C, D, or E, shows the slope. Most symbols without a slope letter are those of nearly level soils, but some are for soils and land types that have a considerable range of slope.

SYMBOL	NAME
Ad	Alluvial land, saline
Ae	Alluvial land, strongly saline
Af	Alluvial land, wet
Ag	Amor loam, sloping
AlD	Amor-Cabba loams, strongly sloping
AmA	Amor-Shambo loams, nearly level
AmB	Amor-Shambo loams, gently sloping
ArA	Arnegard loam, nearly level
ArB	Arnegard loam, gently sloping
Ba	Badland
Bb	Barren badland
BeA	Belfield silt loam, nearly level
BeB	Belfield silt loam, gently sloping
BfA	Belfield silty clay loam, nearly level
BfB	Belfield silty clay loam, gently sloping
Bh	Blown-out land
Bk	Blown-out land-Ladner-Ekalaka complex
BoC	Boxwell loam, sloping
BrD	Boxwell-Cabbart loams, strongly sloping
BtB	Boxwell-Kremlin loams, gently sloping
BuD	Brandenburg-Cabba complex, hilly
CaC	Cabba complex, sloping
CaE	Cabba complex, steep
CbC	Cabba-Amor loams, sloping
CbD	Cabba-Amor loams, hilly
Cd	Cabba-Wayden-Shale outcrop complex
Ce	Cabba and Wayden stony soils
CgC	Cabbart-Boxwell loams, sloping
CgD	Cabbart-Boxwell loams, hilly
ChE	Cabbart complex, steep
Ck	Cabbart-Yawdim-Shale outcrop complex
CmA	Chama and Morton silty clay loams, nearly level
CmB	Chama and Morton silty clay loams, gently sloping
CnC	Chama, Morton, and Cabba silty clay loams, sloping
CoA	Chanta loam, nearly level
CoB	Chanta loam, gently sloping
CrA	Cherry clay loam, nearly level
CrB	Cherry clay loam, gently sloping
CrC	Cherry clay loam, sloping
DaB	Daglum fine sandy loam, gently sloping
DdA	Daglum-Rhoades loams, nearly level
DlC	Dilts and Lisam clays, rolling
DlE	Dilts and Lisam clays, steep
EdB	Ekalaka-Desart fine sandy loams, gently undulating
ElC	Ekalaka-Ladner complex, rolling
EmB	Ekalaka-Zeona-Ladner loamy fine sands, gently sloping
FeE	Flasher complex, steep
FhD	Flasher-Vebar complex, hilly
Fm	Flasher and Vebar very stony soils
FnD	Fleak-Rhame complex, hilly
FoE	Fleak rocky complex, steep
FtE	Fleak-Tusler complex, steep
GdA	Glendive fine sandy loam, nearly level
GdB	Glendive fine sandy loam, undulating
GeA	Grail silt loam, nearly level
GeB	Grail silt loam, gently sloping
GlA	Grail silty clay loam, nearly level
GlB	Grail silty clay loam, gently sloping
Gm	Grail soils, saline
GoA	Grail-Rhoades silty clay loams, nearly level
GoB	Grail-Rhoades silty clay loams, gently sloping
Gp	Gravel pit
Ha	Hanly loamy fine sand
Hc	Hanly soils, channeled
He	Havre loam
Hm	Havre clay loam
Kc	Korchea loam
Ke	Korchea clay loam, wet variant
Kh	Korchea-Havre complex
Km	Korchea-Straw complex
Kn	Korchea and Havre soils, channeled
Ko	Korchea and Straw soils, channeled
KrA	Kremlin loam, nearly level
KrB	Kremlin loam, gently sloping
KsA	Kremlin-Belfield-Rhoades complex, nearly level
La	Lawther silty clay
Lc	Lawther-Rhoades silty clays
LeB	Lefor-Vebar fine sandy loams, gently sloping
LeC	Lefor-Vebar fine sandy loams, sloping
LmC	Lehr, Manning, and Wabek soils, sloping
MaA	Manning fine sandy loam, nearly level
MaB	Manning fine sandy loam, gently sloping
MeB	Marmarth loam, gently sloping
MgC	Marmarth-Cabbart complex, sloping
MhB	Marmarth-Rhame fine sandy loams, gently sloping
MhC	Marmarth-Rhame fine sandy loams, sloping
MkA	Marmarth-Rhoades complex, nearly level
MkB	Marmarth-Rhoades complex, gently sloping
MkC	Marmarth-Rhoades complex, sloping
Mm	Marmarth and Boxwell very stony loams
Mn	McKenzie silty clay
Mo	McKenzie and Heil silty clays
Mp	Mine dumps
MrA	Moreau silty clay, nearly level
MrB	Moreau silty clay, gently sloping
MwC	Moreau-Wayden silty clays, sloping
Ob	Oburn complex
PaA	Parshall fine sandy loam, nearly level
PeB	Patent loam, gently sloping
PeC	Patent loam, sloping
RcC	Reeder-Cabba loams, sloping
RdA	Reeder-Rhoades complex, nearly level
RdB	Reeder-Rhoades complex, gently sloping
RdC	Reeder-Rhoades complex, sloping
ReA	Reeder-Shambo loams, nearly level
ReB	Reeder-Shambo loams, gently sloping
Rf	Reeder and Amor very stony loams
Rg	Regan silt loam
RhA	Regent silty clay loam, nearly level
RhB	Regent silty clay loam, gently sloping
RkC	Regent-Moreau silty clay loams, sloping
RlB	Regent-Moreau-Rhoades complex, gently sloping
RmA	Regent-Rhoades complex, nearly level
RnB	Rhame fine sandy loam, gently sloping
RoC	Rhame-Fleak fine sandy loams, sloping
RoD	Rhame-Fleak fine sandy loams, hilly
RrA	Rhoades-Absher complex, nearly level
RrB	Rhoades-Absher complex, gently sloping
Rt	Rhoades complex, terrace
Rw	Riverwash
SaA	Savage silty clay loam, nearly level
ScA	Savage-Rhoades silty clay loams, nearly level
SeB	Searing loam, gently sloping
SeC	Searing loam, sloping
Sg	Sham soils and Gullied land
ShA	Shambo loam, nearly level
ShB	Shambo loam, gently sloping
SlA	Shambo-Arnegard loams, nearly level
SlB	Shambo-Arnegard loams, gently sloping
SmA	Shambo-Belfield-Rhoades loams, nearly level
SnA	Stady loam, nearly level
SrB	Stady-Lehr loams, gently sloping
SsA	Stady-Shambo loams, nearly level
TaB	Tally fine sandy loam, gently sloping
TaC	Tally fine sandy loam, sloping
TdA	Tally-Parshall fine sandy loams, nearly level
Te	Telfer loamy fine sand
TfC	Telfer-Flasher loamy fine sands, sloping
ToA	Toby fine sandy loam, nearly level
ToB	Toby fine sandy loam, gently sloping
ToC	Toby fine sandy loam, sloping
TrA	Toby loam, nearly level
VfC	Vebar-Flasher fine sandy loams, sloping
VfD	Vebar-Flasher fine sandy loams, hilly
VtB	Vebar-Tally fine sandy loams, gently sloping
Vv	Velva fine sandy loam
Wa	Wabek complex
Wm	Watrous loam
WoC	Wayden-Moreau complex, sloping
Wp	Wolf Point clay
YaC	Yawdim silty clay, sloping
Zd	Zeona fine sand, hummocky
ZeC	Zeona fine sand, undulating
ZfB	Zeona loamy fine sand, gently sloping
ZtC	Zeona-Tusler loamy fine sands, sloping

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 1

1 105 000 FEET

245 000 FEET

SLOPE COUNTY

R. 107 W. | R. 106 W.

T. 132 N.

MONTANA

FALLON COUNTY

(Joins sheet 2)

(Joins sheet 13)

1 125 000 FEET

235 000 FEET

N

1 Mile

5 000 Feet

Scale 1:20 000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 1

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 10

(10)

N

1 340 000 FEET

240 000 FEET

SLOPE COUNTY

R. 100 W. | R. 99 W.

T. 132 N.

(Joins sheet 11)

(Joins sheet 9)

(Joins sheet 22)

225 000 FEET

1 320 000 FEET

Cedar Creek

Scale 1:20 000

1 Mile

5 000 Feet

BOWMAN COUNTY, NORTH DAKOTA NO. 10

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 11

BOWMAN COUNTY, NORTH DAKOTA NO. 11

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

11

N

1 345 000 FEET

240 000 FEET

SLOPE COUNTY

R. 99 W.

T. 132 N.

(Joins sheet 10)

(Joins sheet 12)

(Joins sheet 23)

1 225 000 FEET

1 360 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 12

(12)

N

1 Mile

5 000 Feet

Scale 1:20 000

0 0

1/4 1 000

1/2 2 000

3/4 4 000

1 5 000

1 368 000 FEET

235 000 FEET

SLOPE COUNTY

R. 99 W.

T. 132 N.

ADAMS COUNTY

225 000 FEET

1 365 000 FEET

(Joins sheet 11)

(Joins inset A, sheet 12)

3000 AND 5000-FOOT GRID TICKS

INSET A

(Joins sheet 12)

R. 99 W.

1 368 000 FEET

220 000 FEET

T. 132 N.

ADAMS COUNTY

210 000 FEET

1365 000 FEET

(Joins sheet 23)

(Joins inset B, sheet 12)

3000 AND 5000-FOOT GRID TICKS

INSET B

(Joins inset A, sheet 12)

R. 99 W.

1 367 000 FEET

205 000 FEET

T. 131 N.

ADAMS COUNTY

195 000 FEET

1365 000 FEET

(Joins sheet 34)

(Joins sheet 46)

3000 AND 5000-FOOT GRID TICKS

BOWMAN COUNTY, NORTH DAKOTA NO. 12

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 13

MONTANA

FALLON COUNTY

T. 132 N.

1 105 000 FEET

230 000 FEET

R. 107 W. | R. 106 W.

(Joins sheet 1)

(Joins sheet 14)

(Joins sheet 24)

1 125 000 FEET

1 220 000 FEET

13

N

1 Mile

5 000 Feet

Scale 1:20 000

1 000

2 000

3 000

4 000

5 000

(14)

N

R. 106 W. | R. 105 W.

1 150 000 FEET

230 000 FEET

220 000 FEET

1 130 000 FEET

T. 132 N.

(Joins sheet 2)

(Joins sheet 13)

(Joins sheet 15)

(Joins sheet 25)

MISSOURI RIVER

LITTLE MISSOURI RIVER

Lower Coyote Creek

19 21 22 23 24 25 26 27 28 30 31 33 34 35 36

1 Mile

5 000 Feet

Scale 1:20 000

0 0

1/4 1 000

1/2 2 000

3/4 3 000

4 000

1 5 000

BOWMAN COUNTY, NORTH DAKOTA NO. 14

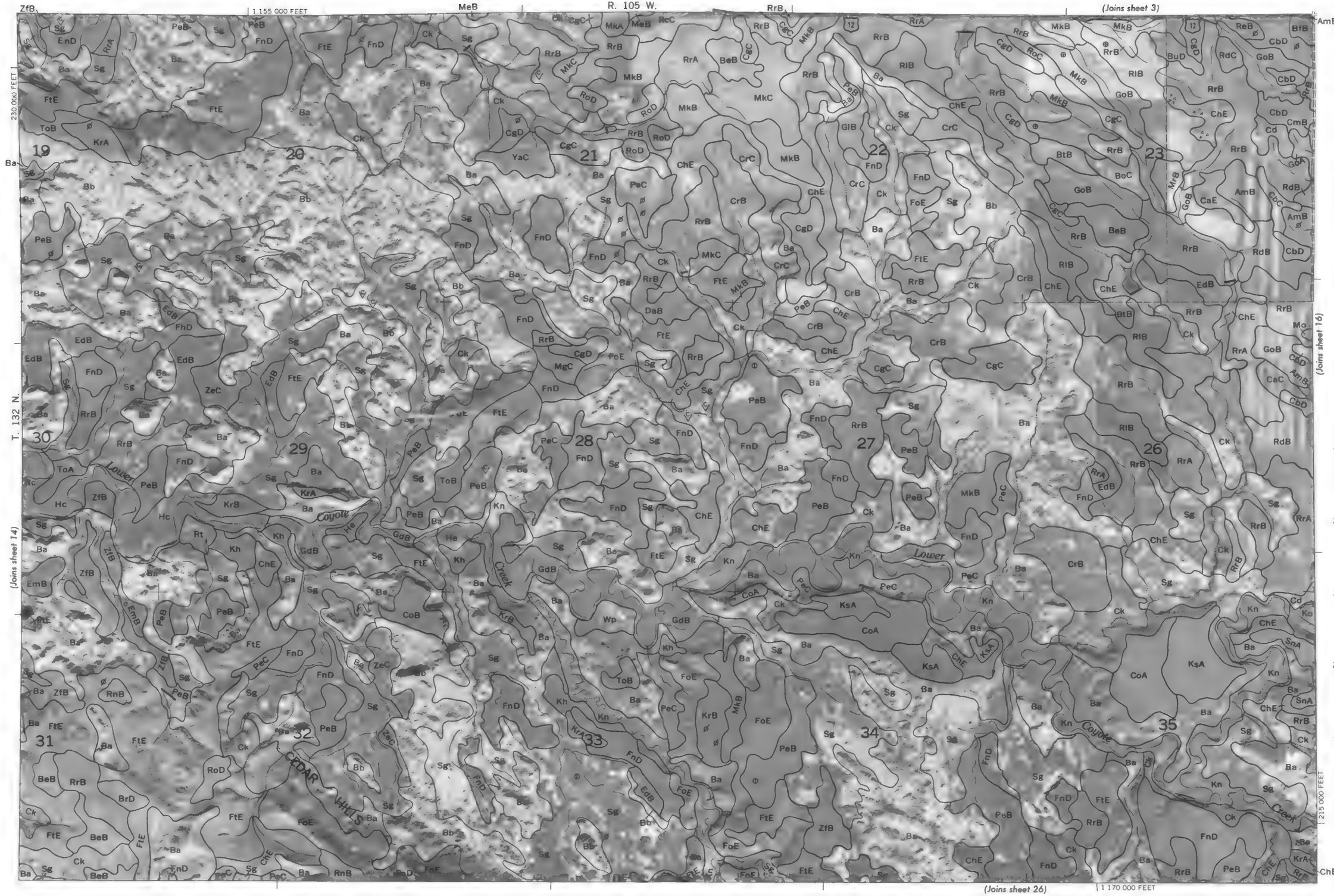
Land division corners are approximately positioned on this map

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 15



BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 16

16

N

R. 105 W. | R. 104 W.

(Joins sheet 4)

1 195 000 FEET

225 000 FEET

(Joins sheet 15)

215 000 FEET

1 175 000 FEET

(Joins sheet 27)

(Joins sheet 17)

T. 132 N.

Scale 1:20 000

1 Mile

5 000 Feet

Post Office

Butte

Spring Lake

Middle Creek

BOWMAN COUNTY, NORTH DAKOTA NO. 16

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 17

17

N

R. 104 W. | R. 103 W.

(Joins sheet 5)

MrB | 1 200 000 FEET

AmB

225 000 FEET

T. 132 N.

(Joins sheet 16)

(Joins sheet 18)

(Joins sheet 28)

1 220 000 FEET

215 000 FEET

Rhame

CHICAGO MILWAUKEE ST. PAUL AND PACIFIC

Scale 1:20 000

1 Mile

5 000 Feet

BOWMAN COUNTY, NORTH DAKOTA NO. 17

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

18

N

1 Mile

5 000 Feet

Scale 1:20 000

(Joins sheet 17)

(Joins sheet 6)

R. 103 W. | R. 102 W. 1 245 000 FEET

225 000 FEET

T. 132 N.

(Joins sheet 19)

1 225 000 FEET

(Joins sheet 29)

215 000 FEET

CHICAGO MILWAUKEE ST PAUL AND PACIFIC

BOWMAN COUNTY, NORTH DAKOTA NO. 18

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 19

19

N

1 Mile

5 000 Feet

Scale 1:20 000

1 250 000 FEET

225 000 FEET

R. 102 W.

(Joins sheet 7)

(Joins sheet 20)

T. 132 N.

(Joins sheet 18)

215 000 FEET

(Joins sheet 30)

1 265 000 FEET

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 19

(2)

N

1 Mile

5 000 Feet

Scale 1:20 000

1 150 000 FEET

245 000 FEET

235 000 FEET

1 130 000 FEET

SLOPE COUNTY

R. 106 W. | R. 105 W.

T. 132 N.

MISSOURI RIVER

LITTLE

(Joins sheet 1)

(Joins sheet 3)

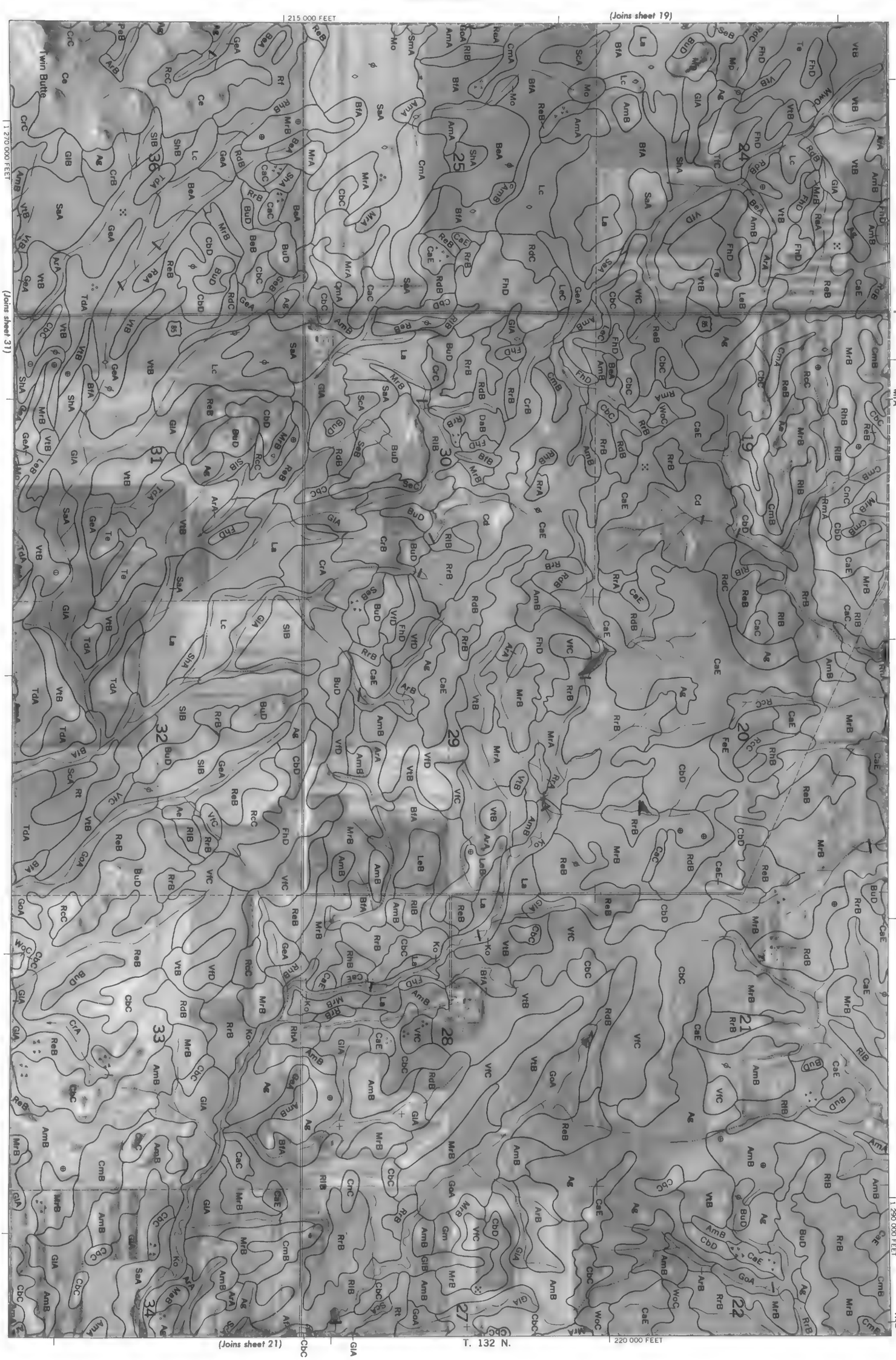
FoE (Joins sheet 14)

BOWMAN COUNTY, NORTH DAKOTA NO. 2

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.



BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 20

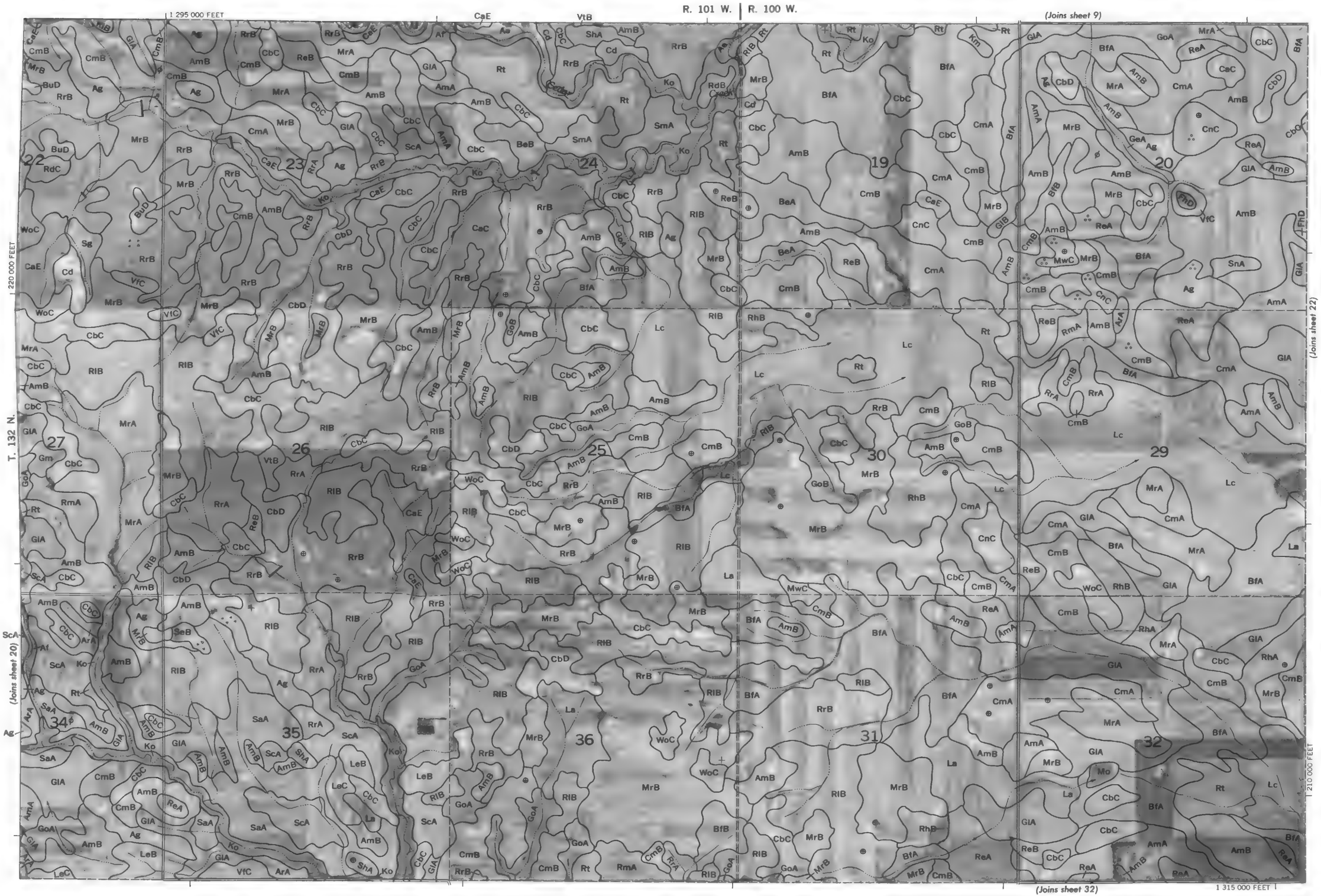
BOWMAN COUNTY, NORTH DAKOTA NO. 20

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 21



21

N

1 Mile

5 000 Feet

Scale 1:20 000

BOWMAN COUNTY, NORTH DAKOTA NO. 21

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

N

(Joins sheet 10)

1 335 000 FEET R. 100 W. | R. 99 W.

(Joins sheet 21)

1 210 000 FEET

T. 132 N.

1 220 000 FEET

(Joins sheet 23)

(Joins sheet 33) 1 320 000 FEET

Scale 1:20 000

1 Mile 5 000 Feet

0 0

¼ 1 000

½ 2 000

¾ 4 000

5 000

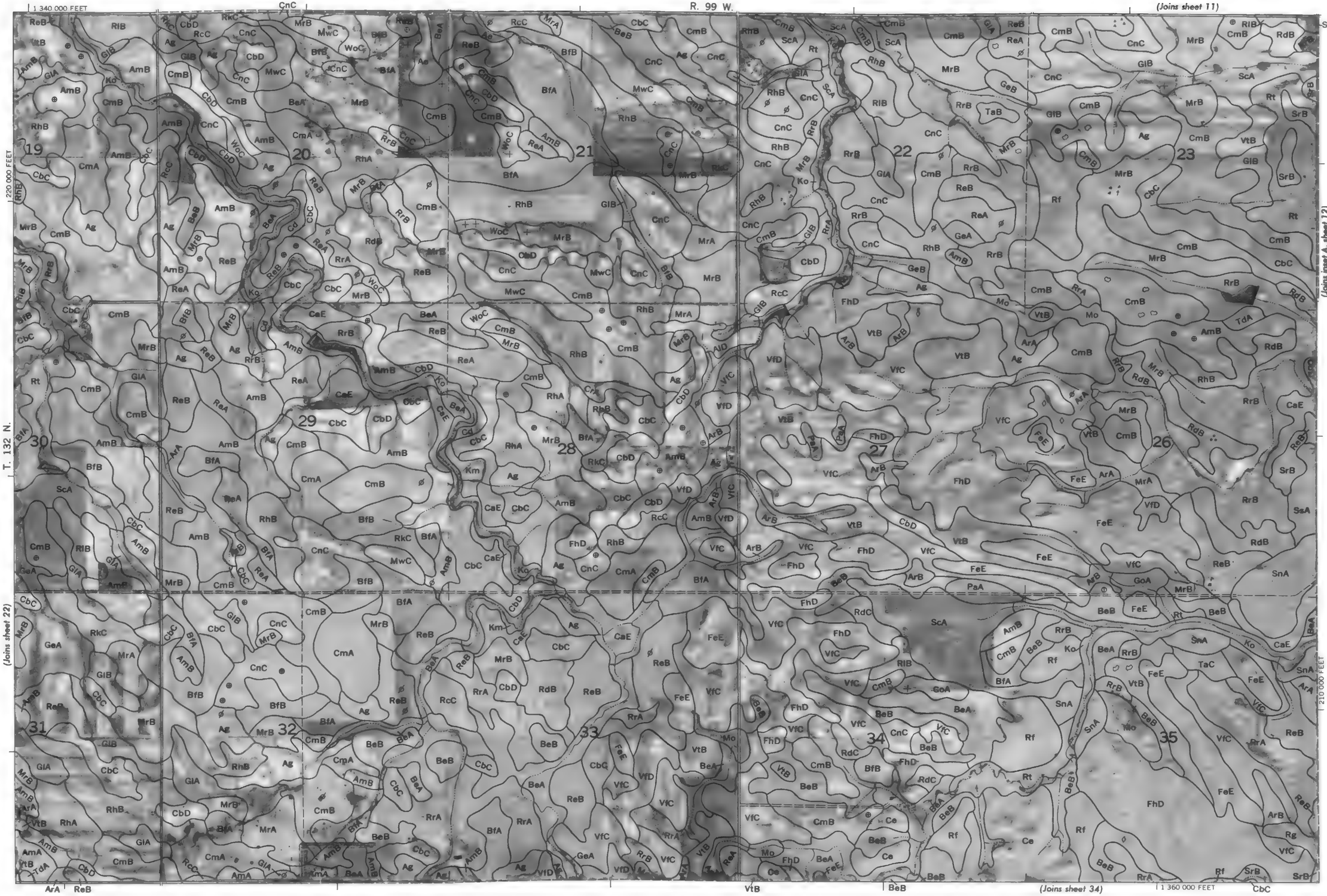
BOWMAN COUNTY, NORTH DAKOTA NO. 22

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 23



23

N

1 Mile

5 000 Feet

Scale 1:20 000

BOWMAN COUNTY, NORTH DAKOTA NO. 23

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

(24)

N

(Joins sheet 13)

R. 107 W. | R. 106 W.

1 125 000 FEET

215 000 FEET

MONTANA

FALLON COUNTY

T. 131 N.

205 000 FEET

1 105 000 FEET

(Joins sheet 35)

(Joins sheet 25)

1 Mile

5 000 Feet

Scale 1:20 000

1 5 000 | ¾ 4 000 | ½ 3 000 | ¼ 2 000 | 0 1 000 | 0

BOWMAN COUNTY, NORTH DAKOTA NO. 24

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 25

1 130 000 FEET

215 000 FEET

R. 106 W. | R. 105 W.

(Joins sheet 14)

T. 131 N.

(Joins sheet 24)

(Joins sheet 26)

(Joins sheet 36)

1 145 000 FEET

200 000 FEET

LITTLE MISSOURI RIVER

MISSOURI RIVER

Spring Creek

25

N

1 Mile

5 000 Feet

Scale 1:20 000

N

1 Mile 5 000 Feet

Scale 1:20 000

R. 105 W.

T. 131 N.

1 170 000 FEET

210 000 FEET

200 000 FEET

1 150 000 FEET

(Join sheet 15)

(Joins sheet 25)

(Joins sheet 27)

(Joins sheet 37)

CEDAR RIVER HILLS

Spring Creek

BOWMAN COUNTY, NORTH DAKOTA NO. 26

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

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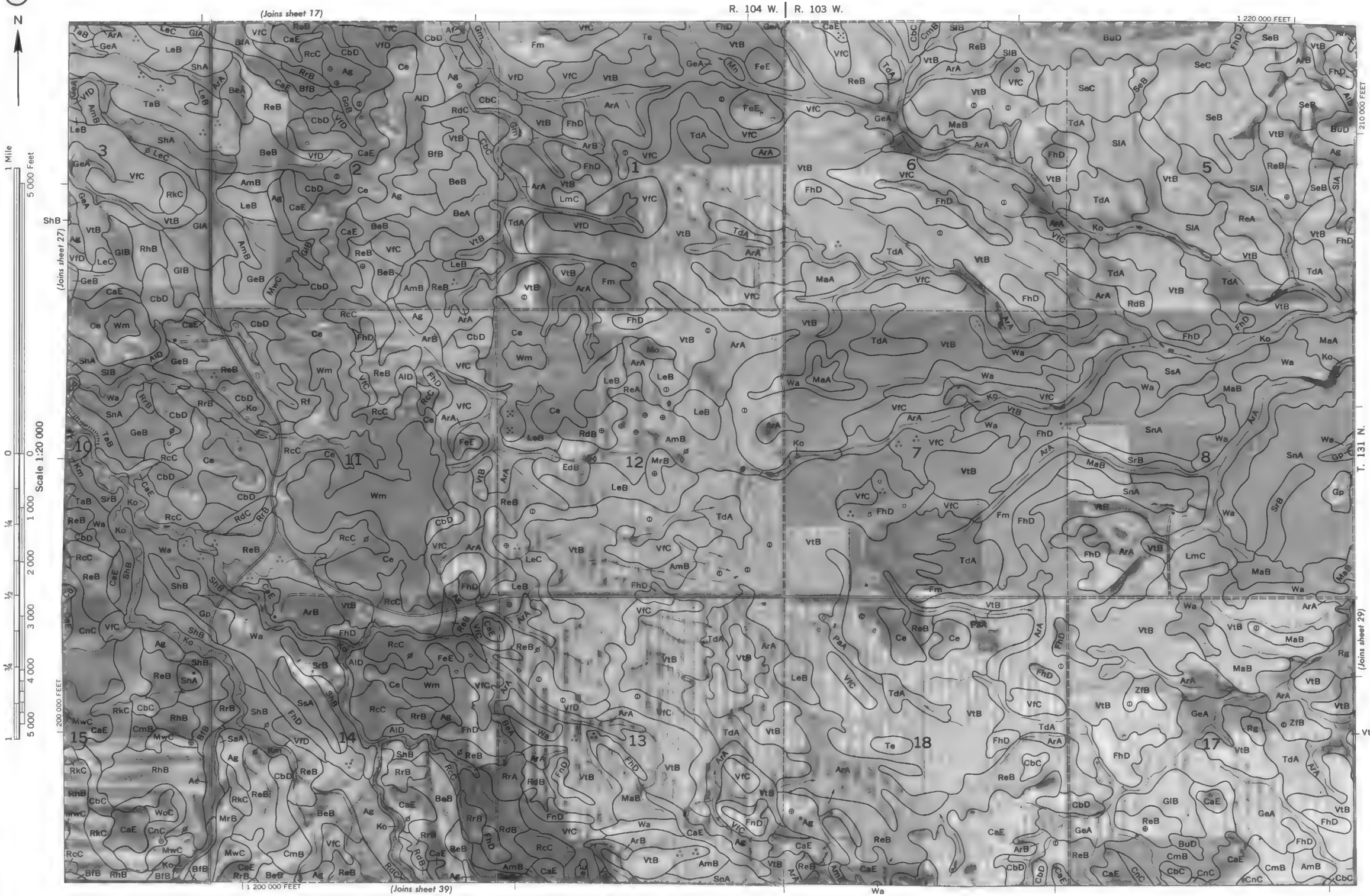
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 27

(28)

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 28



BOWMAN COUNTY, NORTH DAKOTA NO. 28

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 29

29

BOWMAN COUNTY, NORTH DAKOTA NO. 29

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

1 225 000 FEET

210 000 FEET

R. 103 W. | R. 102 W.

(Joins sheet 18)

T. 131 N.

(Joins sheet 28)

(Joins sheet 40)

1 240 000 FEET

200 000 FEET

(Joins sheet 30)

N

1 Mile

5 000 Feet

Scale 1:20 000

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 3

NORTH DAKOTA NO. 3

BOWMAN COUNTY, NORTH DAKOTA

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

1 155 000 FEET

245 000 FEET

R. 105 W.

SLOPE COUNTY

T. 132 N.

(Joins sheet 2)

(Joins sheet 4)

(Joins sheet 15)

1 170 000 FEET

230 000 FEET

Fort Dilts Historic Site

MILWAUKEE ST PAUL AND PACIFIC

N

Scale 1:20 000

1 Mile

5 000 Feet

30

N

R. 102 W.

T. 131 N.

(Joins sheet 19)

(Joins sheet 29)

(Joins sheet 31)

(Joins sheet 41)

1 265 000 FEET

210 000 FEET

1 245 000 FEET

200 000 FEET

CHICAGO MILWAUKEE ST PAUL AND PACIFIC

BOWMAN MUNICIPAL AIRPORT

BOWMAN county seat

BOWMAN CEMETERY

SEWAGE DISPOSAL

Twin Buttes

Scale 1:20 000

1 Mile

5 000 Feet

BOWMAN COUNTY, NORTH DAKOTA NO. 30

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 31

1 270 000 FEET

R. 102 W. | R. 101 W.

(Joins sheet 20)

210 000 FEET

T. 131 N.

(Joins sheet 30)

(Joins sheet 32)

(Joins sheet 42)

1 290 000 FEET

1 295 000 FEET

BOWMAN (county seat)

Miller Landing Strip

Talbot Butte

PACIFIC AND ST PAUL MILWAUKEE CHICAGO

31

N

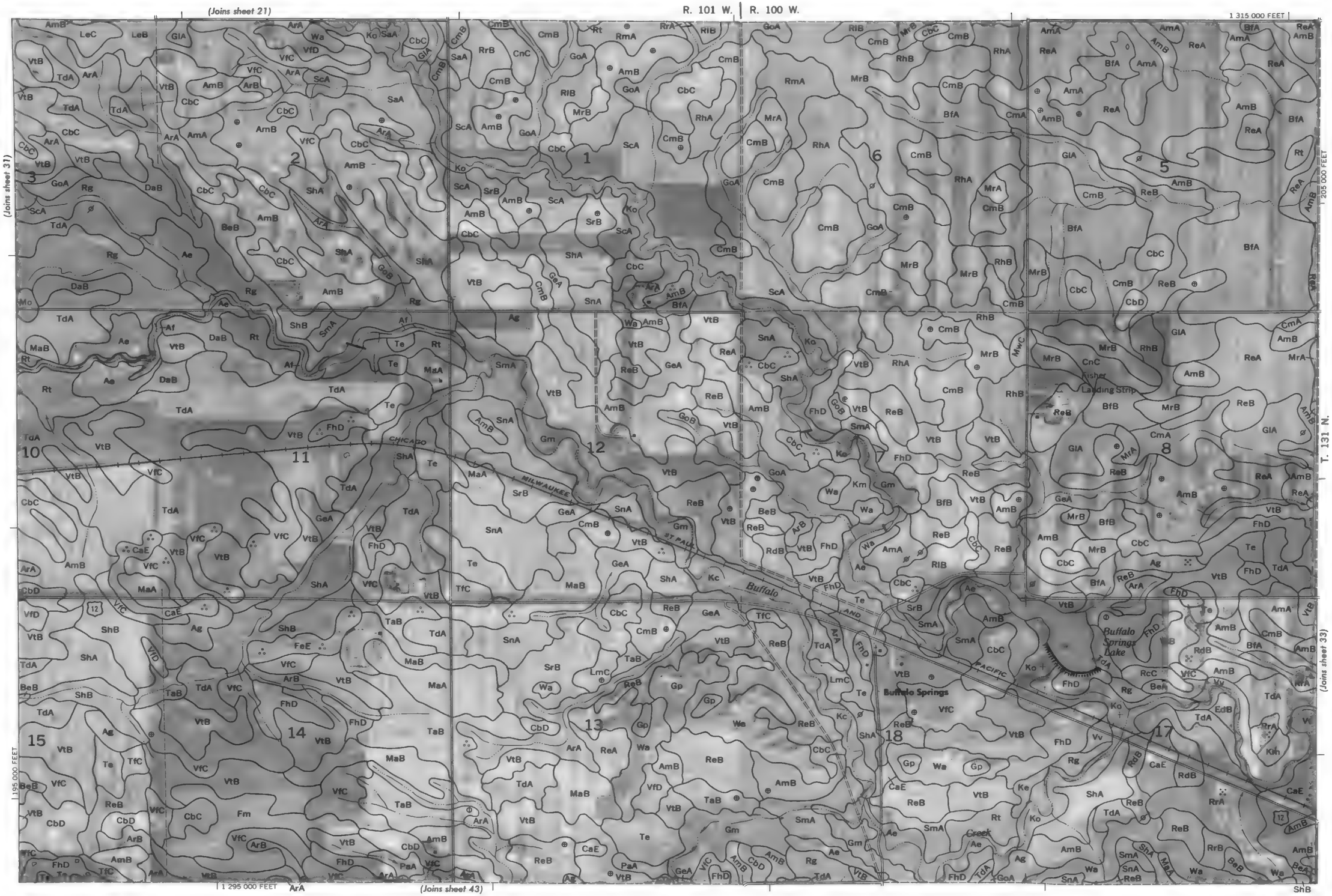
1 Mile

5 000 Feet

Scale 1:20 000

(32)

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 32



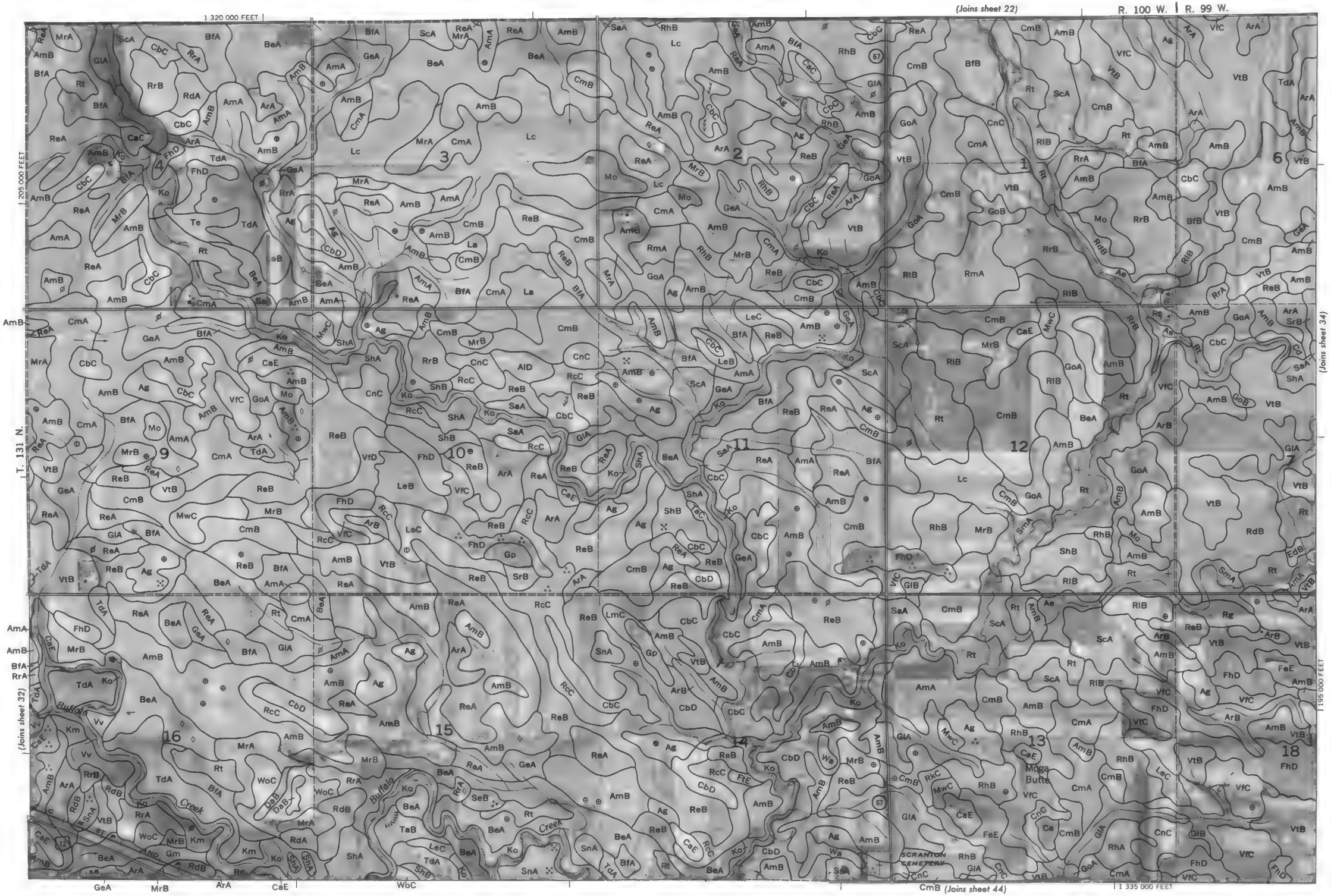
BOWMAN COUNTY, NORTH DAKOTA NO. 32

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 33



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 33

33

N

1 Mile

5 000 Feet

0 0

1:20 000

Scale 1:20 000

1 5 000 | ¼ 1 000 | ½ 2 000 | ¾ 3 000 | 4 000 | 5 000

(34)

N

(Joins sheet 23)

R. 99 W.

1 360 000 FEET

205 000 FEET

(Joins sheet 33)

T. 131 N.

(Joins inset B, sheet 12)

1 Mile

5 000 Feet

Scale 1:20 000

195 000 FEET

1 340 000 FEET

(Joins sheet 45)

BOWMAN COUNTY, NORTH DAKOTA NO. 34

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 35

35

N

R. 107 W. | R. 106 W.

T. 131 N.

MONTANA — FALLON COUNTY

1 105 000 FEET

200 000 FEET

(Joins sheet 24)

(Joins sheet 36)

(Joins sheet 47)

1 125 000 FEET

185 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 35

BOWMAN COUNTY, NORTH DAKOTA NO. 36

Land division corners are approximately positioned on this map

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 37

37

N

1 Mile

5 000 Feet

Scale 1:20 000

1 150 000 FEET

1 195 000 FEET

1 185 000 FEET

1 170 000 FEET

R. 105 W.

T. 131 N.

(Joins sheet 26)

(Joins sheet 38)

(Joins sheet 36)

(Joins sheet 49)

Sunset Butte

Spring Creek

Skull Creek

19 20 21 22 23 30 29 28 27 26 31 32 33 34 35

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 37

(38)

N

R. 105 W. | R. 104 W.

(Joins sheet 27)

(Joins sheet 37)

(Joins sheet 39)

(Joins sheet 50)

1 195 000 FEET

195 000 FEET

T. 131 N.

1 Mile

5 000 Feet

Scale 1:20 000

1 5 000 0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 3 000

BOWMAN COUNTY, NORTH DAKOTA NO. 38

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 39

39

N

R. 104 W. | R. 103 W.

1 200 000 FEET

195 000 FEET

T. 131 N.

(Joins sheet 28)

(Joins sheet 40)

(Joins sheet 38)

(Joins sheet 51)

185 000 FEET

1 215 000 FEET

Scale 1:20 000

1 Mile

5 000 Feet

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

4

N

1 Mile

5 000 Feet

Scale 1:20 000

1 195 000 FEET

245 000 FEET

R. 105 W. | R. 104 W.

SLOPE COUNTY

T. 132 N.

(Joins sheet 3)

(Joins sheet 5)

(Joins sheet 16)

1 175 000 FEET

230 000 FEET

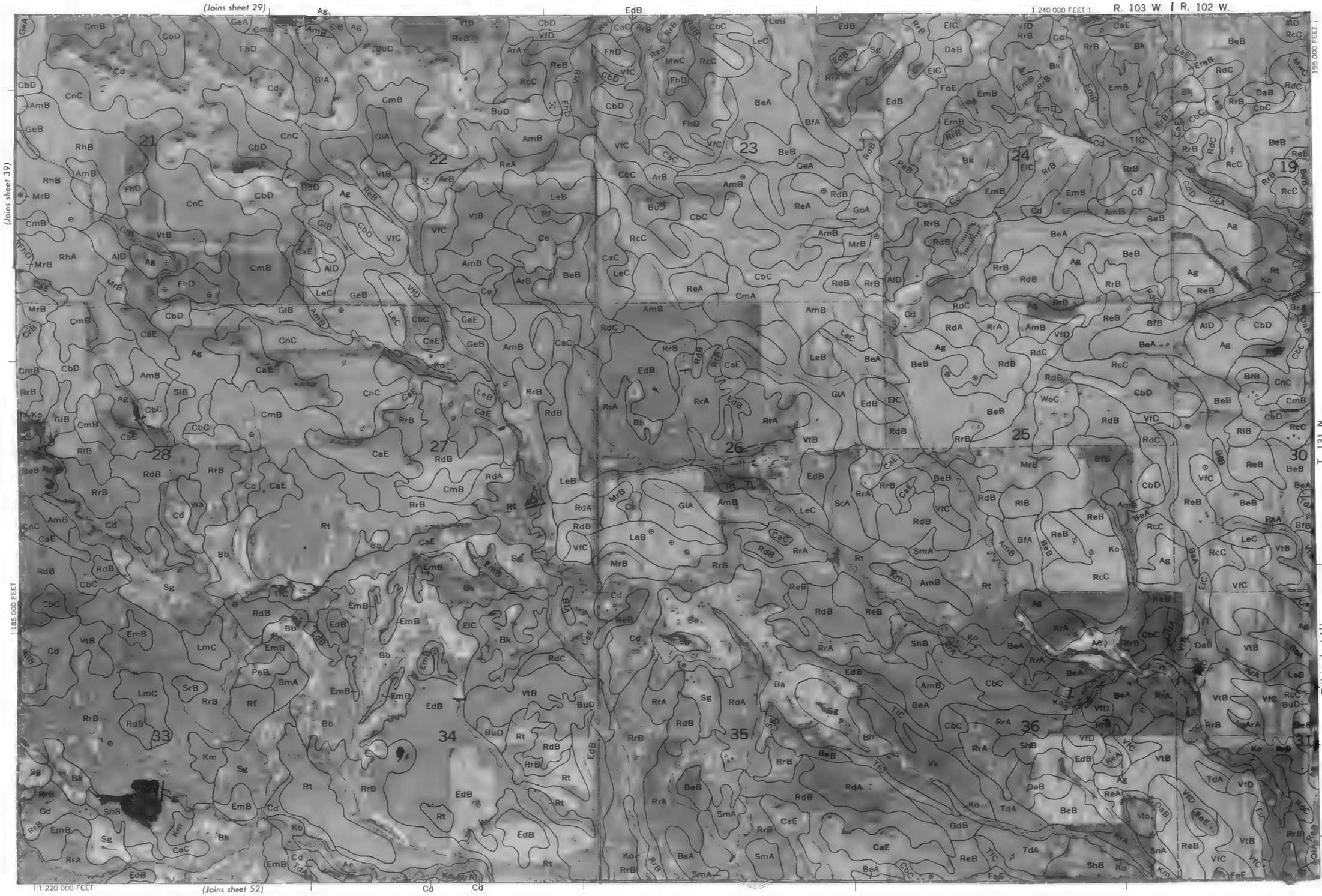
CHICAGO MILWAUKEE ST. PAUL AND PACIFIC

BOWMAN COUNTY, NORTH DAKOTA NO. 4

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.



Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 41

41

N

R. 102 W

T. 131 N.

(Joins sheet 30)

(Joins sheet 40)

(Joins sheet 42)

(Joins sheet 53)

1 245 000 FEET

195 000 FEET

180 000 FEET

1 265 000 FEET

Kalina Lake

Harvey Hills

Spring Creek

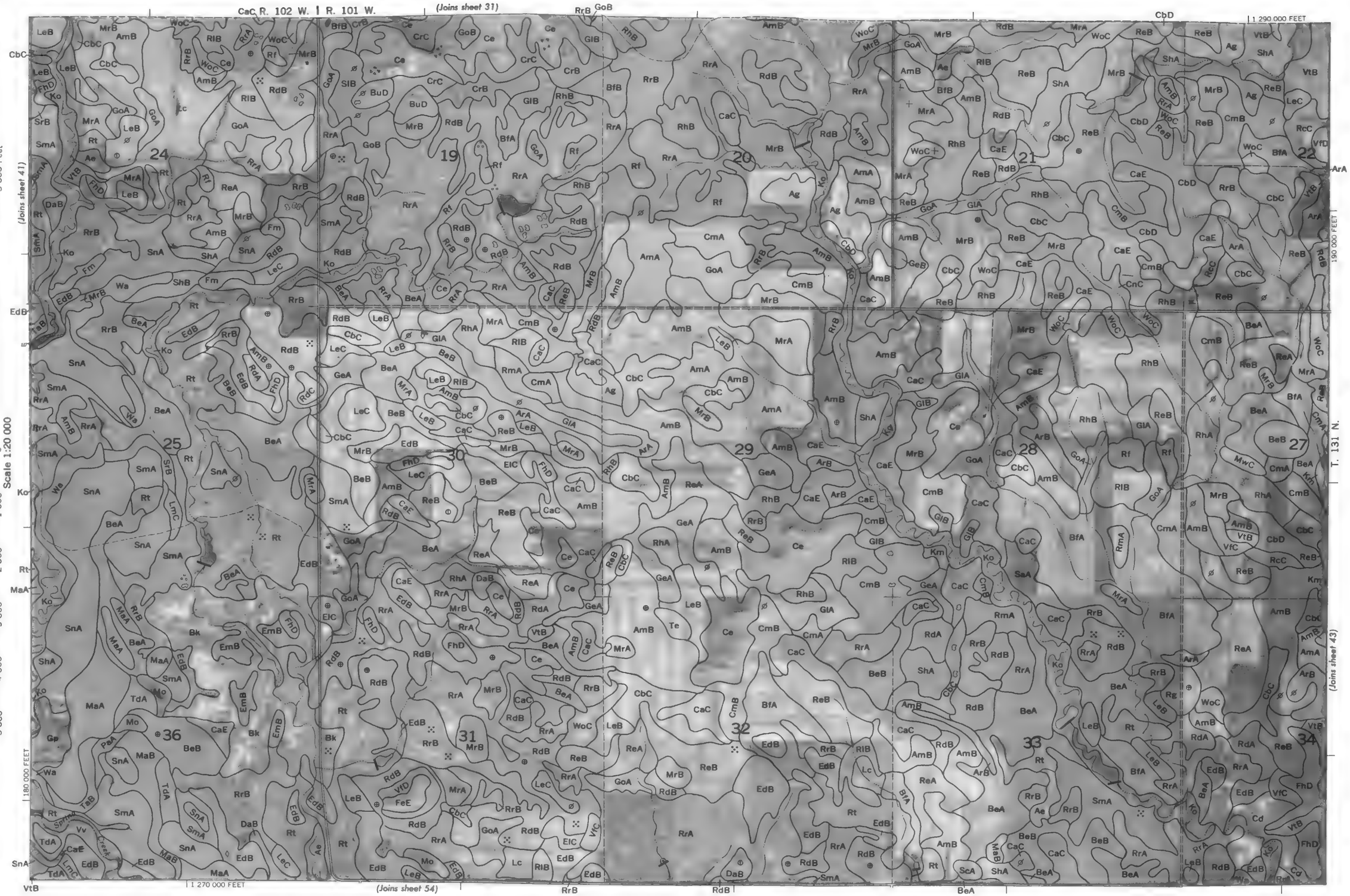
Golf Course

19 20 21 22 23 26 27 28 29 30 31 32 33 34 35

1 Mile

5 000 Feet

Scale 1:20 000



BOWMAN COUNTY, NORTH DAKOTA NO. 42

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 43

43

N

R. 101 W. | R. 100 W.

1 295 000 FEET

190 000 FEET

T. 131 N.

(Joins sheet 42)

(Joins sheet 32)

(Joins sheet 44)

(Joins sheet 55)

1 310 000 FEET

180 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

0 0

1/4 1 000

1/2 2 000

3/4 3 000

1 4 000

5 000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 43

(44)

N

1 Mile

5 000 Feet

Scale 1:20 000

0 0 ¼ ½ ¾ 1

5 000 1 000 2 000 3 000 4 000

180 000 FEET

1 335 000 FEET | R. 100 W. | R. 99 W. | 190 000 FEET

T. 131 N.

(Joins sheet 43)

(Joins sheet 33)

(Joins sheet 56)

(Joins sheet 45)

1 315 000 FEET

Scranton

Buffalo Creek

Chicago, Milwaukee, St. Paul and Pacific

Sewage Disposal

21 22 23 24 19 28 27 26 25 30 38 34 35 36 31

BOWMAN COUNTY, NORTH DAKOTA NO. 44

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 45

1 340 000 FEET

R. 99 W.

RhB (Joins sheet 34)

190 000 FEET

T. 131 N.

(Joins sheet 44)

(Joins sheet 46)

(Joins sheet 57)

180 000 FEET

1 360 000 FEET

GASCOYNE LAKE

Gascoyne

Buffalo Creek

CHICAGO MILWAUKEE ST PAUL AND PACIFIC

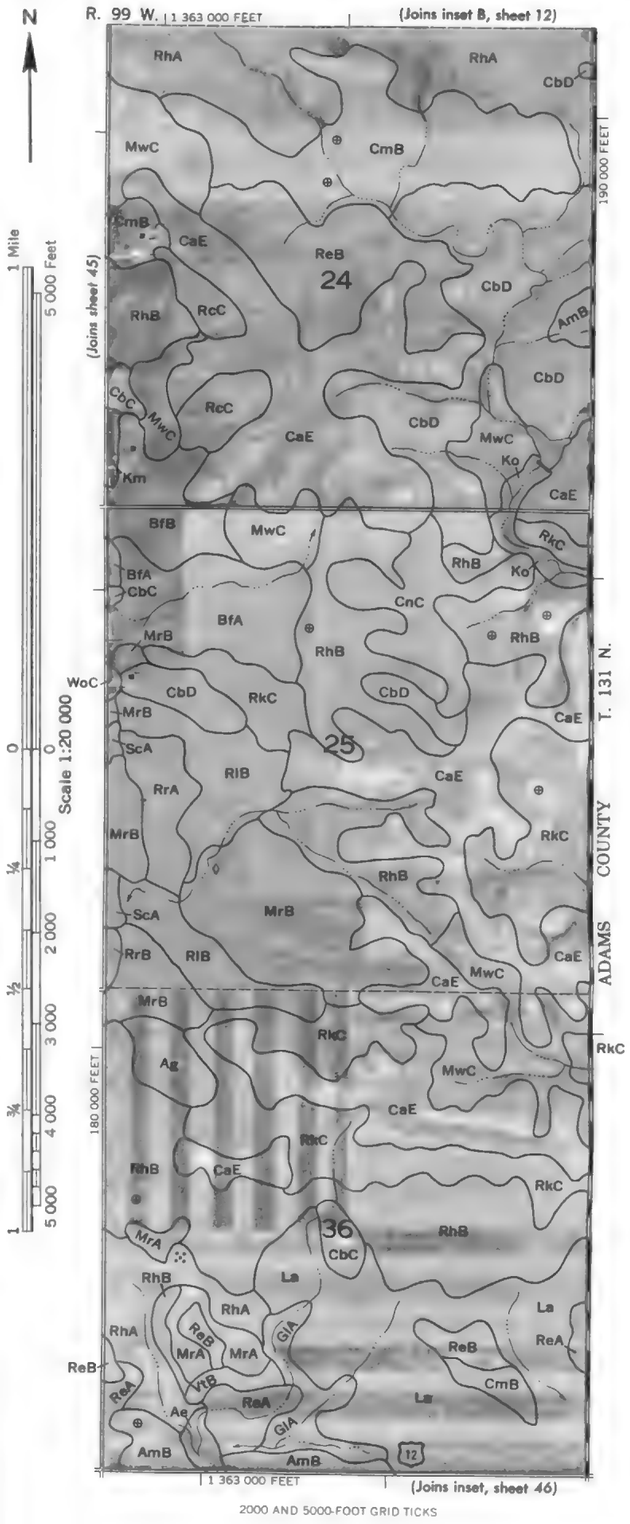
45

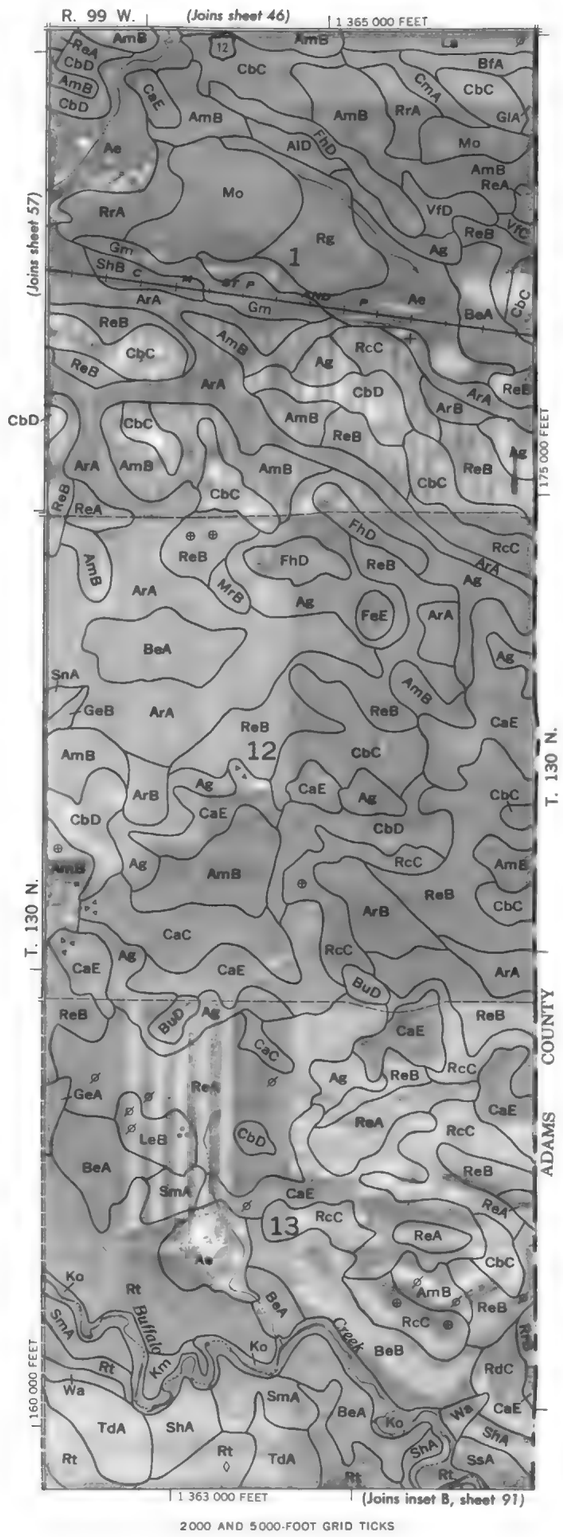
N

1 Mile

5 000 Feet

Scale 1:20 000



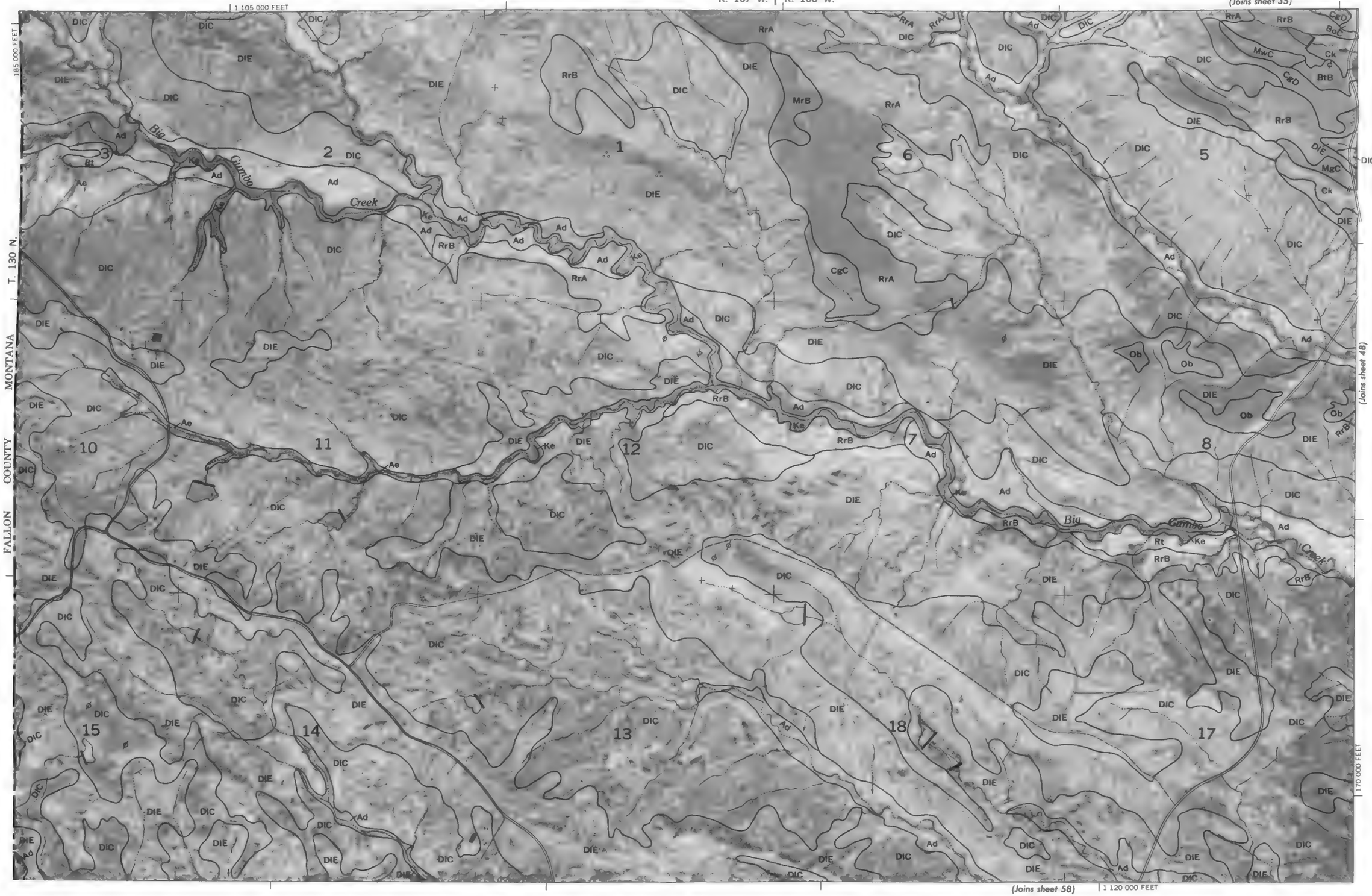


BOWMAN COUNTY, NORTH DAKOTA NO. 46

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.



BOWMAN COUNTY, NORTH DAKOTA NO. 47

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

(48)

N

(Joins sheet 36)

1 145 000 FEET | R. 106 W. | R. 105 W.

T. 130 N.

(Joins sheet 49)

(Joins sheet 47)

1 125 000 FEET

(Joins sheet 59)

170 000 FEET

180 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

BOWMAN COUNTY, NORTH DAKOTA NO. 48

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

ROWMAN COUNTY, NORTH DAKOTA NO. 49

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 5

1 200 000 FEET

245 000 FEET

R. 104 W. | R. 103 W.

SLOPE COUNTY

(Joins sheet 4)

(Joins sheet 6)

(Joins sheet 17)

1 220 000 FEET

1 230 000 FEET

5

N

1 Mile

5 000 Feet

Scale 1:20 000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 5

50

N

(Joins sheet 38)

R. 105 W. | R. 104 W.

1 195 000 FEET

180 000 FEET

T. 130 N.

(Joins sheet 49)

170 000 FEET

1 175 000 FEET

(Joins sheet 61)

(Joins sheet 51)

MkA

KrA

1 Mile

5 000 Feet

Scale 1:20 000

1 0 1 2 3 4 Miles

5 000 0 5 000 1 000 2 000 3 000 4 000 Feet

BOWMAN COUNTY, NORTH DAKOTA NO. 50

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 51

BOWMAN COUNTY, NORTH DAKOTA NO. 51

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

N

R. 103 W. | R. 102 W.

1 240 000 FEET

(Joins sheet 40)

(Joins sheet 51)

(Joins sheet 53)

(Joins sheet 63)

1 220 000 FEET

165 000 FEET

175 000 FEET

T. 130 N.

1 Mile 5 000 Feet

Scale 1:20 000

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

BOWMAN COUNTY, NORTH DAKOTA NO. 52

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 53

1 245 000 FEET

R. 102 W.

(Joins sheet 41)

1 175 000 FEET

T. 130 N.

(Joins sheet 52)

(Joins sheet 54)

(Joins sheet 64)

1 265 000 FEET

53

N

1 Mile

5 000 Feet

Scale 1:20 000

5 000 0 0

1 000 ¼ ¼

2 000 ½ ½

3 000 ¾ ¾

4 000 1 1

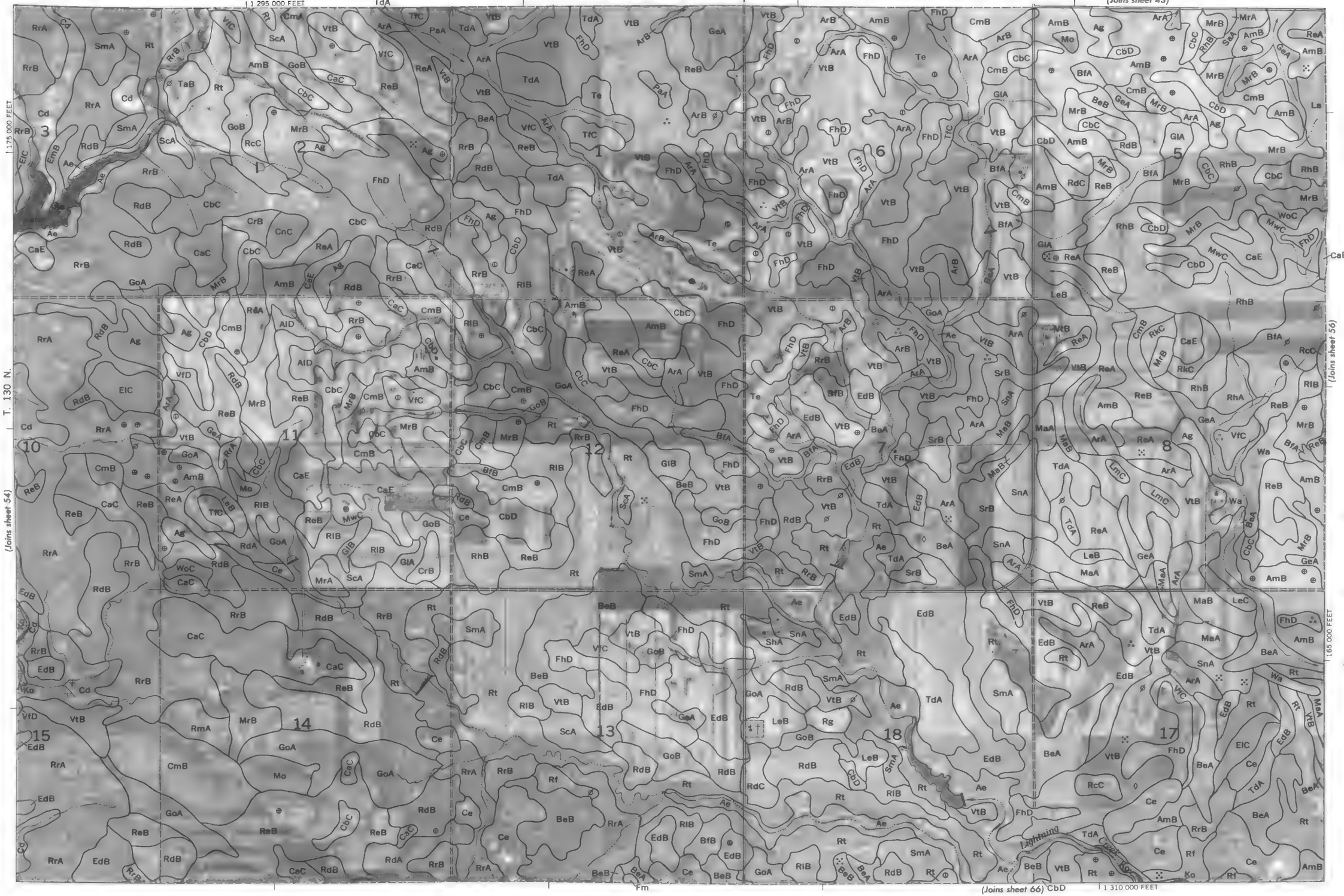
BOWMAN COUNTY, NORTH DAKOTA NO. 54

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 55



55

N

1 Mile

5 000 Feet

Scale 1:20 000

1 5 000 | ¾ 4 000 | ½ 3 000 | ¼ 2 000 | 0 1 000 | 0

BOWMAN COUNTY, NORTH DAKOTA NO. 55

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone
Land division corners are approximately positioned on this map.

56

N

R. 100 W. | R. 99 W.

1 335 000 FEET

175 000 FEET

T. 130 N.

165 000 FEET

1 315 000 FEET

(Joins sheet 44)

(Joins sheet 55)

(Joins sheet 57)

(Joins sheet 67)

intermittent

1 Mile

5 000 Feet

Scale 1:20 000

BOWMAN COUNTY, NORTH DAKOTA NO. 56

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

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This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 57

1 340 000 FEET

R. 99 W.

(Joins sheet 45)

175 000 FEET

T. 130 N.

(Joins sheet 56)

(Joins inset, sheet 46)

(Joins sheet 68)

1 160 000 FEET

FhD

Buffalo

Creek

MILWAUKEE — CHICAGO — ST PAUL AND PACIFIC

57

N

1 Mile

5 000 Feet

Scale 1:20 000

N

1 Mile

5 000 Feet

0

1:20 000

Scale 1:20 000

1 000 2 000 3 000 4 000 5 000

1/4 1/2 3/4 1

(Joins sheet 47)

R. 107 W. | R. 106 W.

1 120 000 FEET

165 000 FEET

155 000 FEET

1 100 000 FEET

MONTANA

COUNTY

FALLON

T. 130 N.

RIVER

MISSOURI

LITTLE

(Joins sheet 59)

(Joins sheet 69)

BOWMAN COUNTY, NORTH DAKOTA NO. 58

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 59

1 125 000 FEET

1 165 000 FEET

R. 106 W. | R. 105 W.

(Joins sheet 48)

T. 130 N.

(Joins sheet 58)

(Joins sheet 60)

(Joins sheet 70)

1 155 000 FEET

1 145 000 FEET

59

N

1 Mile 5 000 Feet

Scale 1:20 000

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

6

N

1 Mile

5 000 Feet

Scale 1:20 000

1 245 000 FEET

240 000 FEET

SLOPE COUNTY

R. 103 W. | R. 102 W.

T. 132 N.

(Joins sheet 5)

(Joins sheet 7)

230 000 FEET

1 225 000 FEET

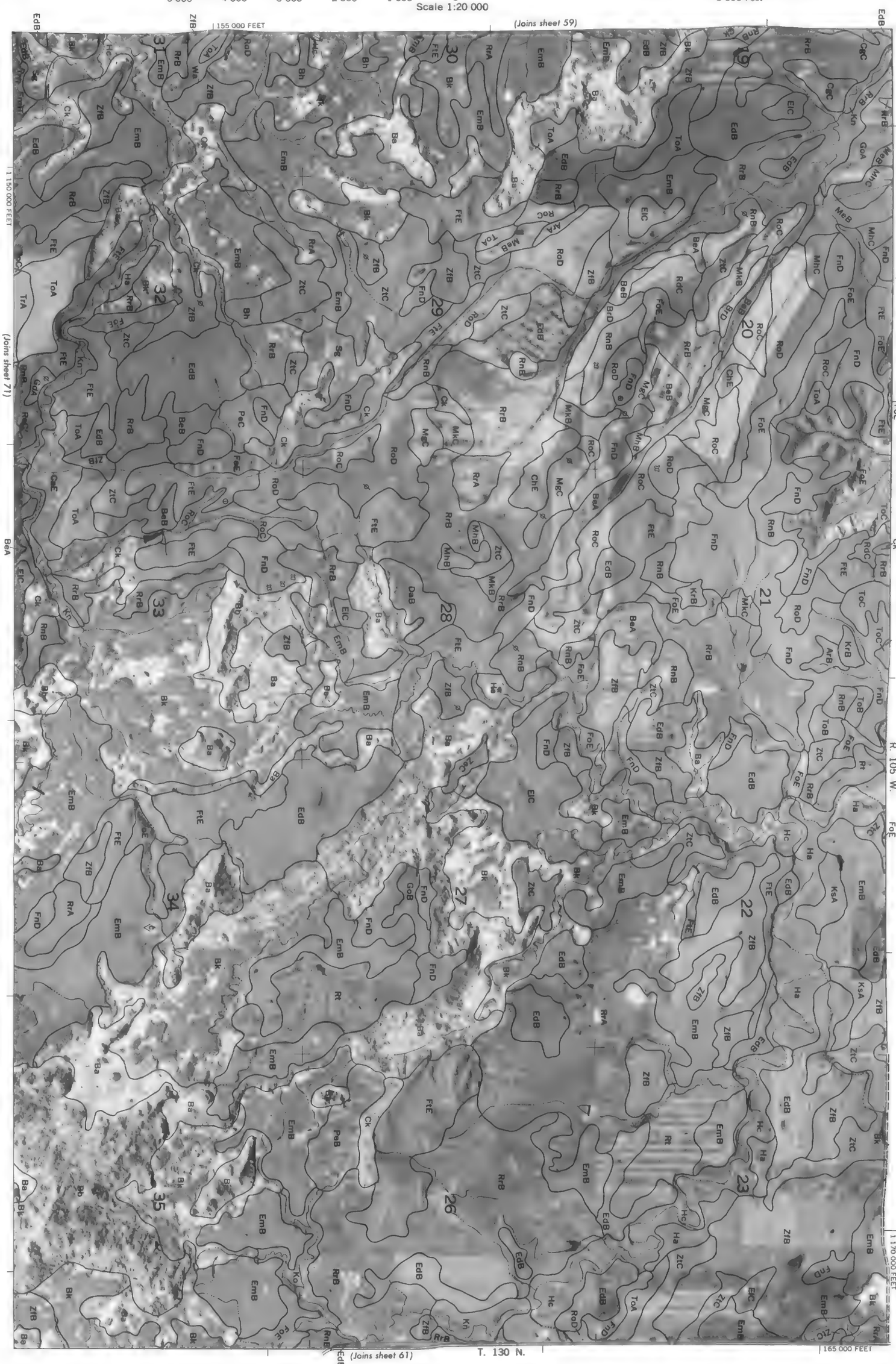
(Joins sheet 18)

BOWMAN COUNTY, NORTH DAKOTA NO. 6

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.



BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 60

BOWMAN COUNTY, NORTH DAKOTA NO. 60

Land division corners are approximately positioned on this map

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 61

61

N

R. 105 W. | R. 104 W.

1 175 000 FEET

165 000 FEET

T. 130 N.

(Joins sheet 50)

(Joins sheet 60)

(Joins sheet 62)

(Joins sheet 72)

1 195 000 FEET

1 150 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

62

N

R. 104 W. | R. 103 W.

(Joins sheet 51)

1 215 000 FEET

1 160 000 FEET

T. 130 N.

(Joins sheet 63)

(Joins sheet 61)

1 150 000 FEET

(Joins sheet 73)

1 200 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

BOWMAN COUNTY, NORTH DAKOTA NO. 62

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 63

63

N

R. 103 W. | R. 102 W.

1 220 000 FEET

1 160 000 FEET

T. 130 N.

(Joins sheet 52)

(Joins sheet 62)

(Joins sheet 64)

(Joins sheet 74)

1 240 000 FEET

1 150 000 FEET

1 Mile

5 000 Feet

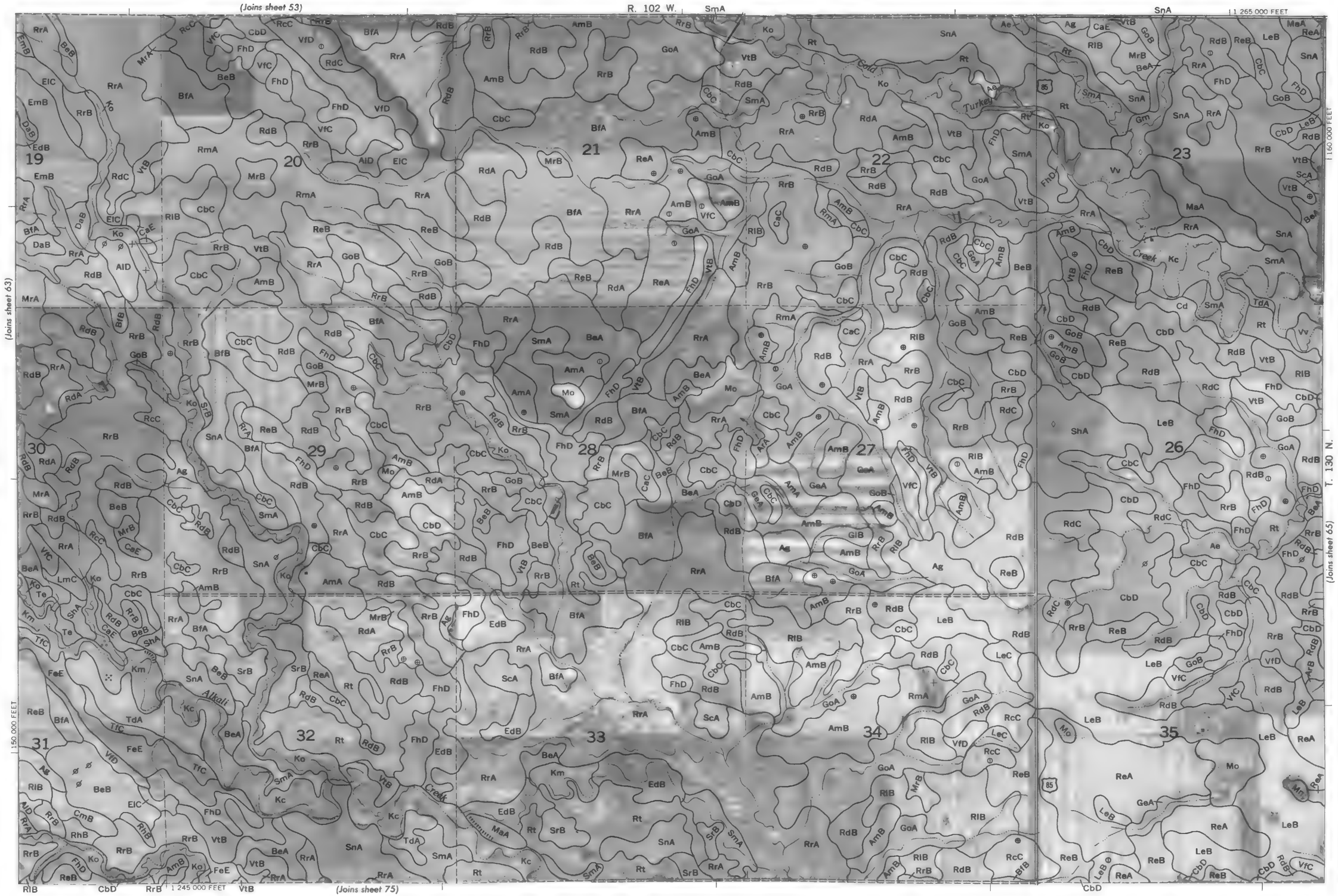
Scale 1:20 000

BOWMAN COUNTY, NORTH DAKOTA NO. 63

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

Land division corners are approximately positioned on this map.

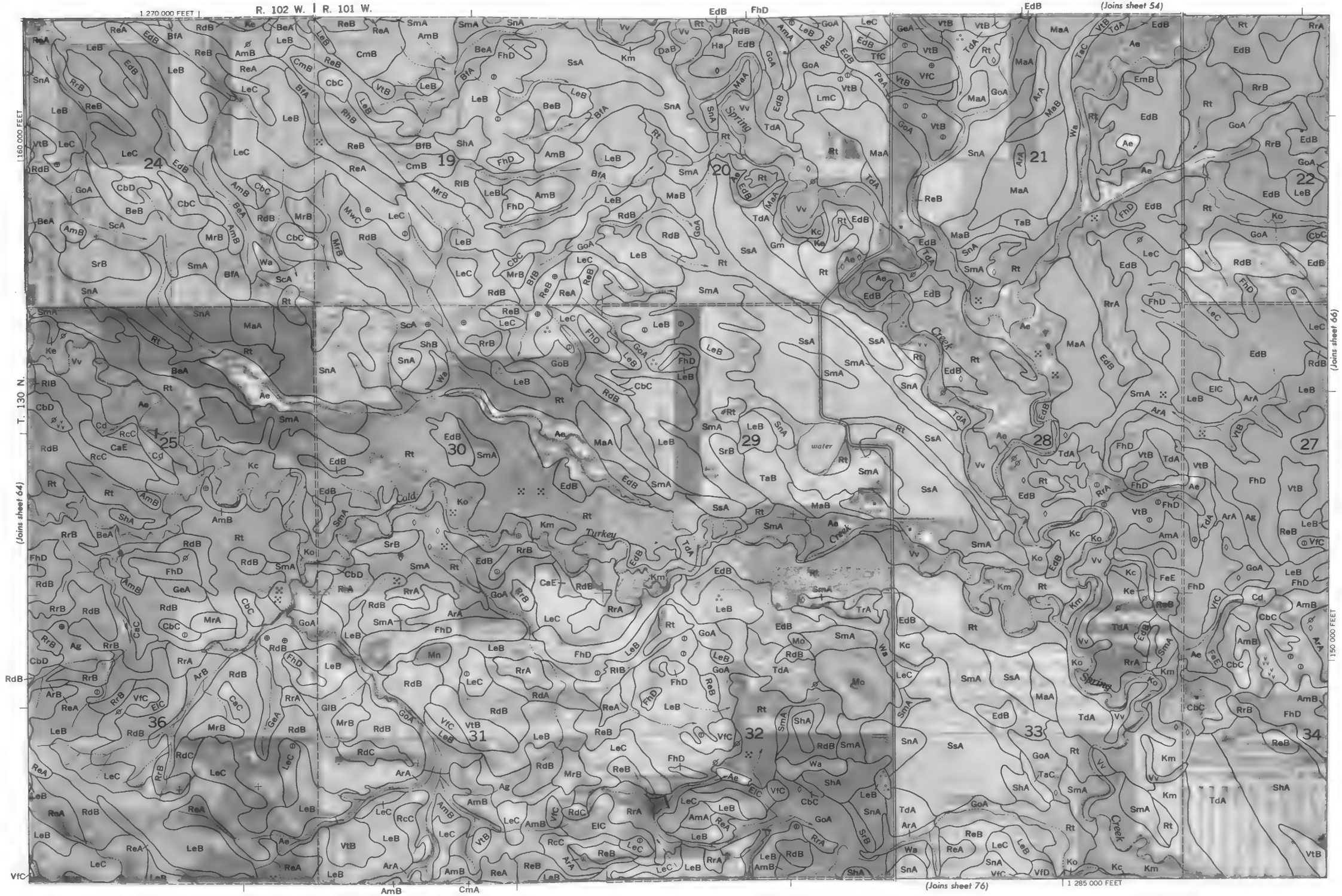


BOWMAN COUNTY, NORTH DAKOTA NO. 64

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximately positioned on this map.

Land division corners are approximately positioned on this map.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.



BOWMAN COUNTY, NORTH DAKOTA NO. 65

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

N

R. 101 W. | R. 100 W.

T. 130 N.

1 310 000 FEET

160 000 FEET

150 000 FEET

1 290 000 FEET

(Joins sheet 55)

(Joins sheet 65)

(Joins sheet 67)

(Joins sheet 77)

1 Mile 5 000 Feet

Scale 1:20 000

BOWMAN COUNTY, NORTH DAKOTA NO. 66

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximately positioned on this map.

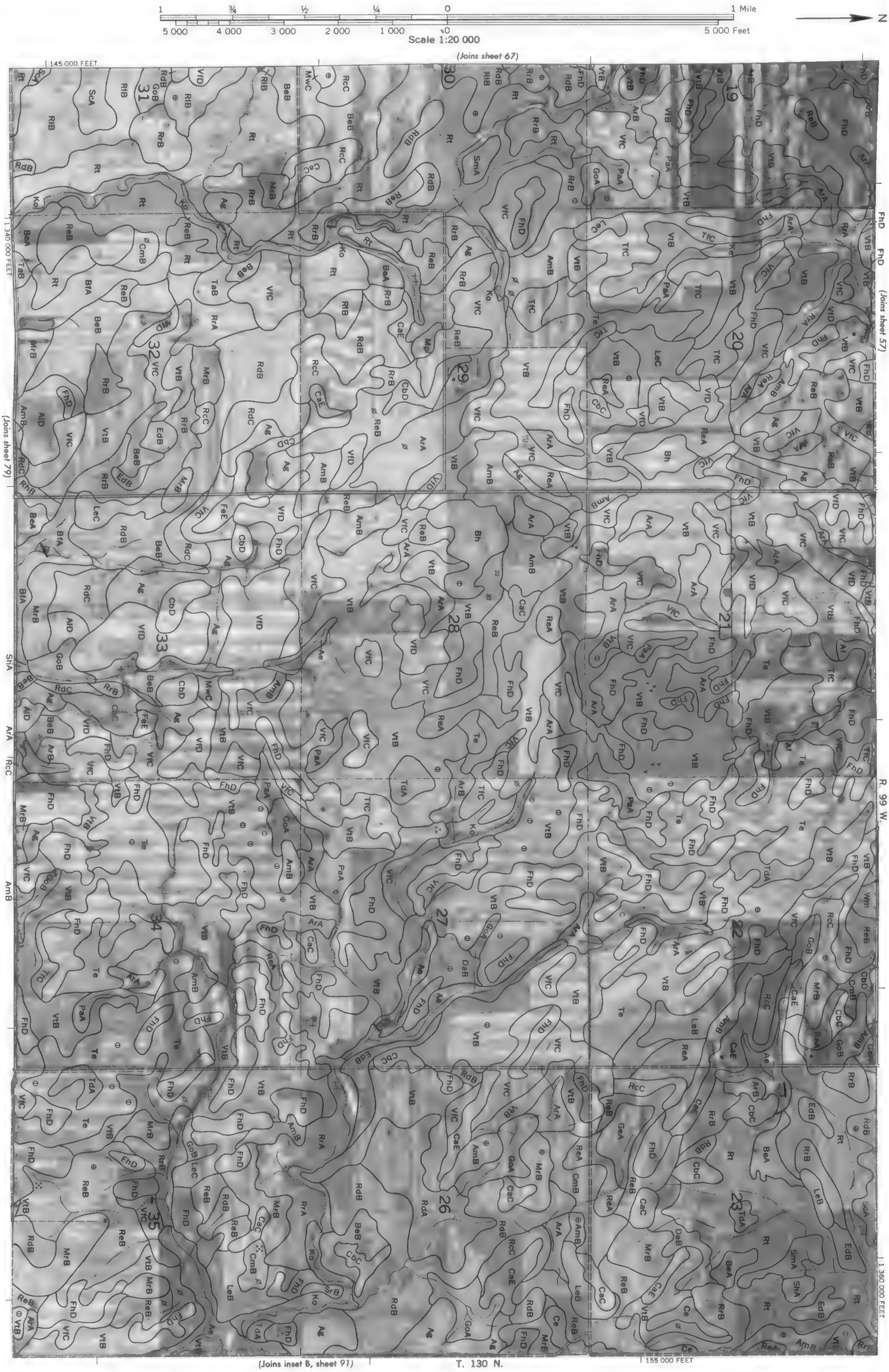
Land division corners are approximately and based on the North Dakota coordinate system south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 67

BOWMAN COUNTY, NORTH DAKOTA NO. 67

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station. Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone. Land division corners are approximately positioned on this map.



BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 68

BOWMAN COUNTY, NORTH DAKOTA NO. 68

Land division corners are approximately positioned on this map

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 69

69

N

BOWMAN COUNTY, NORTH DAKOTA NO. 69

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

1 100 000 FEET

R. 107 W. | R. 106 W.

(Joins sheet 58)

150 000 FEET

MONTANA

COUNTY

FALLON

T. 129 N.

LITTLE MISSOURI RIVER

(Joins sheet 70)

(Joins sheet 80)

1 120 000 FEET

1 Mile

5 000 Feet

140 000 FEET

Scale 1:20 000

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 7

7

N

1 250 000 FEET

240 000 FEET

R. 102 W.

SLOPE COUNTY

T. 132 N.

(Joins sheet 6)

(Joins sheet 8)

(Joins sheet 19)

1 265 000 FEET

230 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 7

70

N

R. 106 W. | R. 105 W.

1 145 000 FEET

150 000 FEET

T. 129 N.

(Joins sheet 59)

(Joins sheet 69)

(Joins sheet 71)

(Joins sheet 81)

140 000 FEET

1 125 000 FEET

MISSOURI RIVER

LITTLE GIA

1 Mile

5 000 Feet

Scale 1:20 000

1 0 5 000 | ¼ 0 1 000 | ½ 2 000 | ¾ 4 000 | 3 000

BOWMAN COUNTY, NORTH DAKOTA NO. 70

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 71

1 150 000 FEET

150 000 FEET

R. 105 W.

(Joins sheet 60)

T. 129 N.

(Joins sheet 70)

(Joins sheet 72)

(Joins sheet 82)

1 170 000 FEET

135 000 FEET

71

N

1 Mile

5 000 Feet

Scale 1:20 000

0 0

1/4 1 000

1/2 2 000

3/4 4 000

1 5 000

BOWMAN COUNTY, NORTH DAKOTA NO. 72

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 73

73

N

R. 104 W. | R. 103 W.

1 200 000 FEET

145 000 FEET

T. 129 N.

(Joins sheet 72)

(Joins sheet 74)

(Joins sheet 62)

(Joins sheet 84)

1 215 000 FEET

135 000 FEET

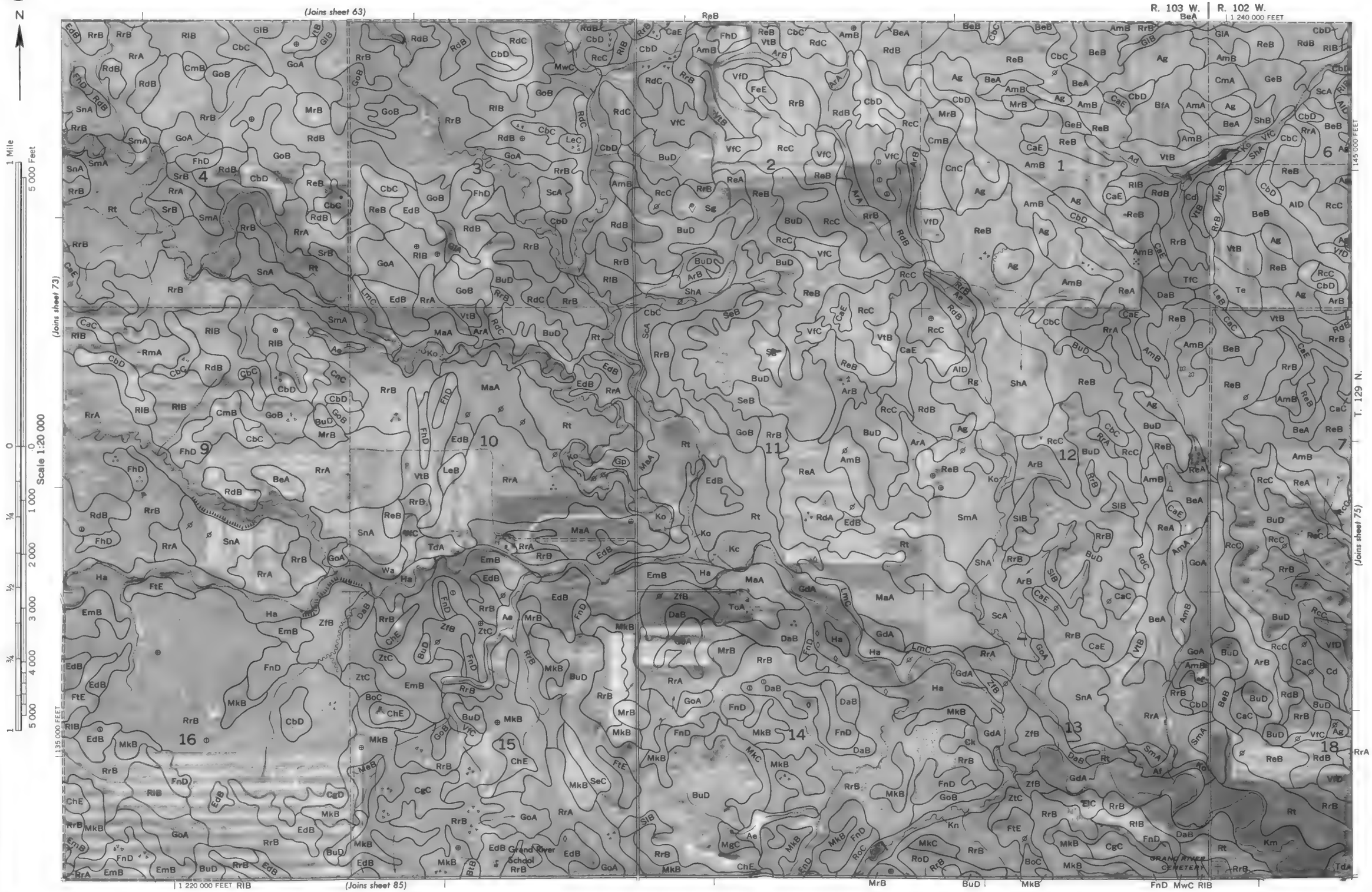
1 Mile

5 000 Feet

Scale 1:20 000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 73



BOWMAN COUNTY, NORTH DAKOTA NO. 74

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

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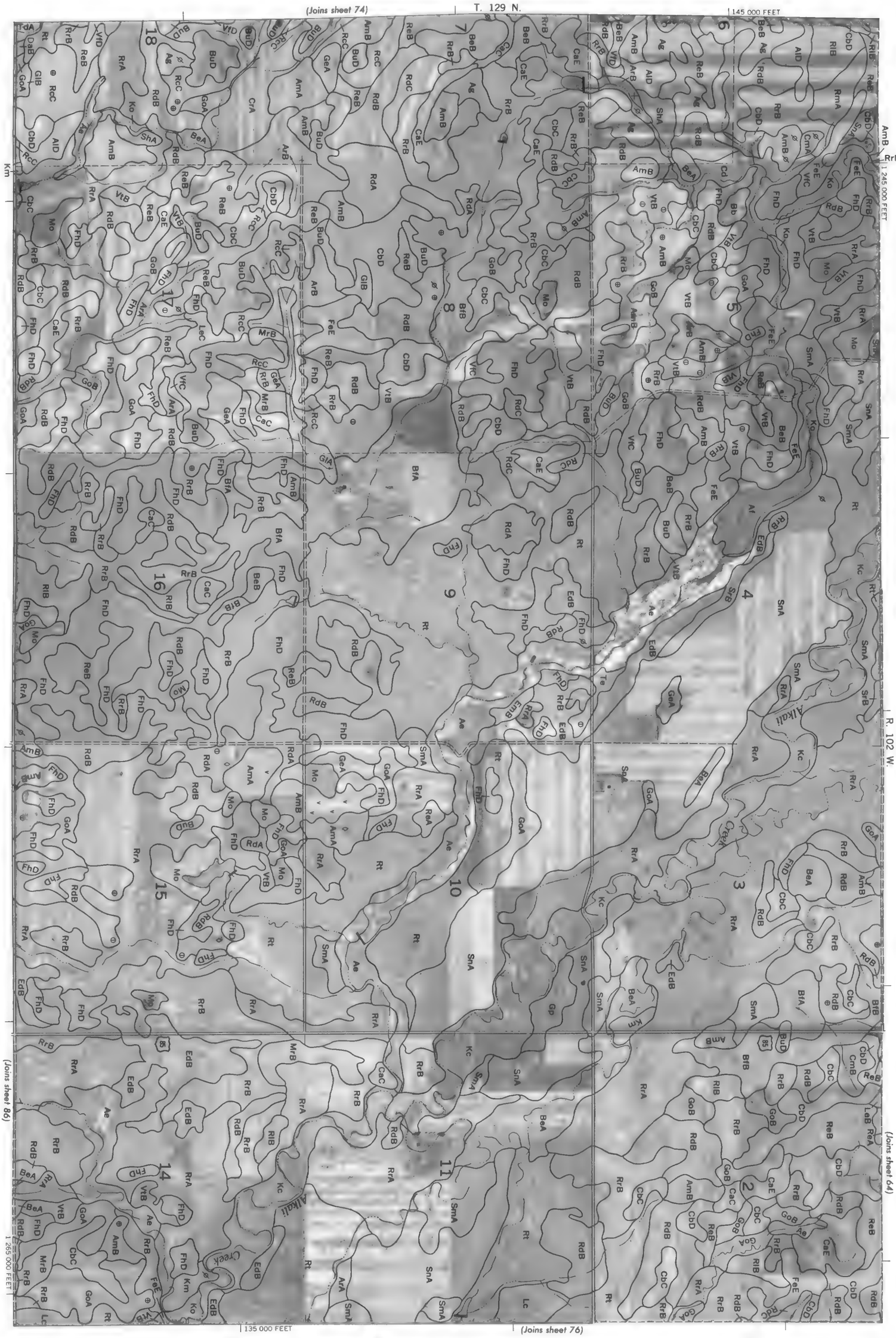
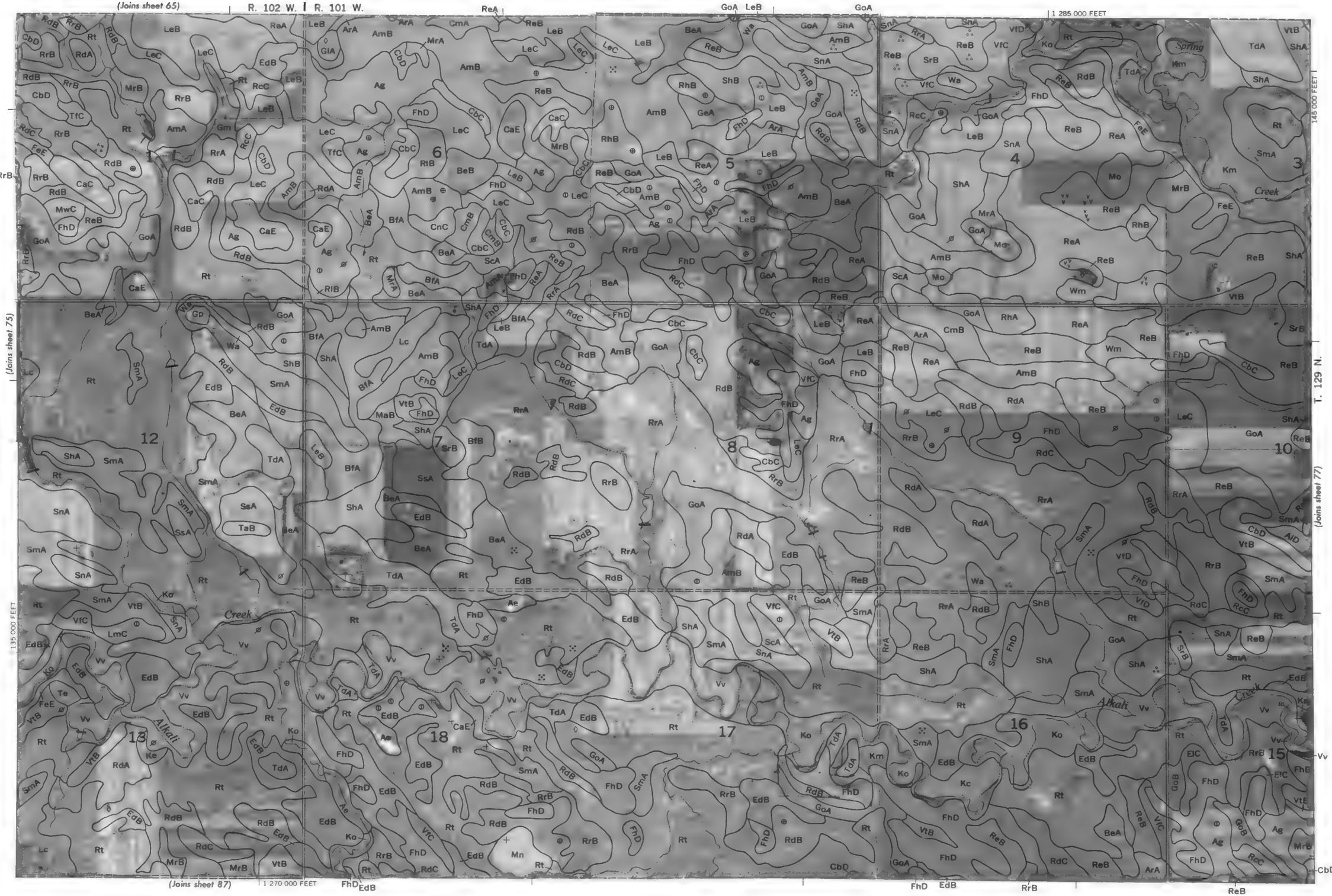
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 75



BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 75



BOWMAN COUNTY, NORTH DAKOTA NO. 76

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

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Land division corners are approximately positioned on this map

BOWMAN COUNTY, NORTH DAKOTA NO. 77

77

N

1 290 000 FEET

145 000 FEET

R. 101 W. | R. 100 W.

T. 129 N.

(Joins sheet 66)

(Joins sheet 76)

(Joins sheet 78)

(Joins sheet 88)

1 310 000 FEET

130 000 FEET

BOWMAN-HALEY RESERVOIR

Spring Creek

1 Mile

5 000 Feet

Scale 1:20 000

N

R. 100 W. | R. 99 W.

1 335 000 FEET

140 000 FEET

T. 129 N.

(Joins sheet 67)

(Joins sheet 77)

(Joins sheet 79)

(Joins sheet 89)

1 315 000 FEET

130 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

BOWMAN COUNTY, NORTH DAKOTA NO. 78

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

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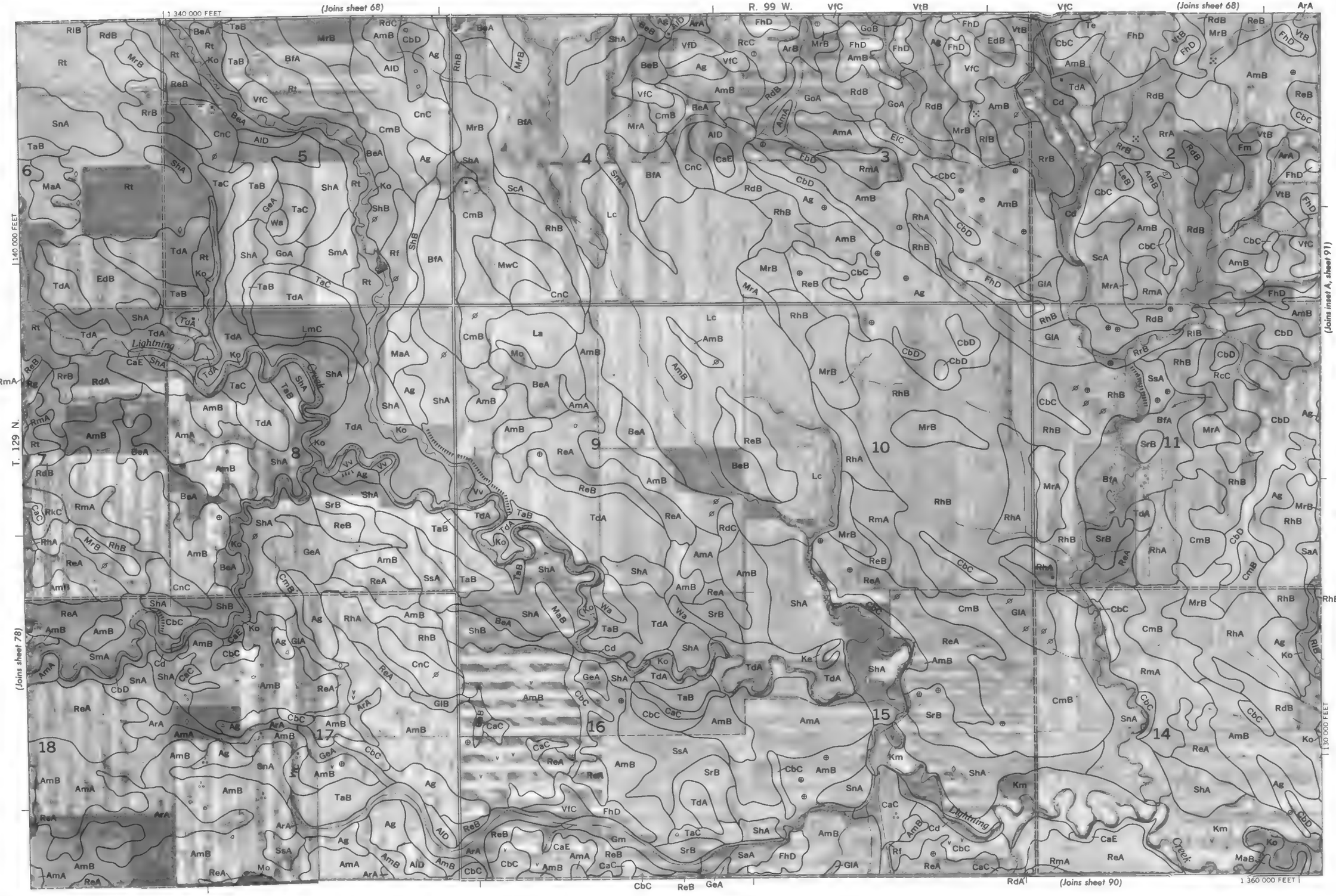
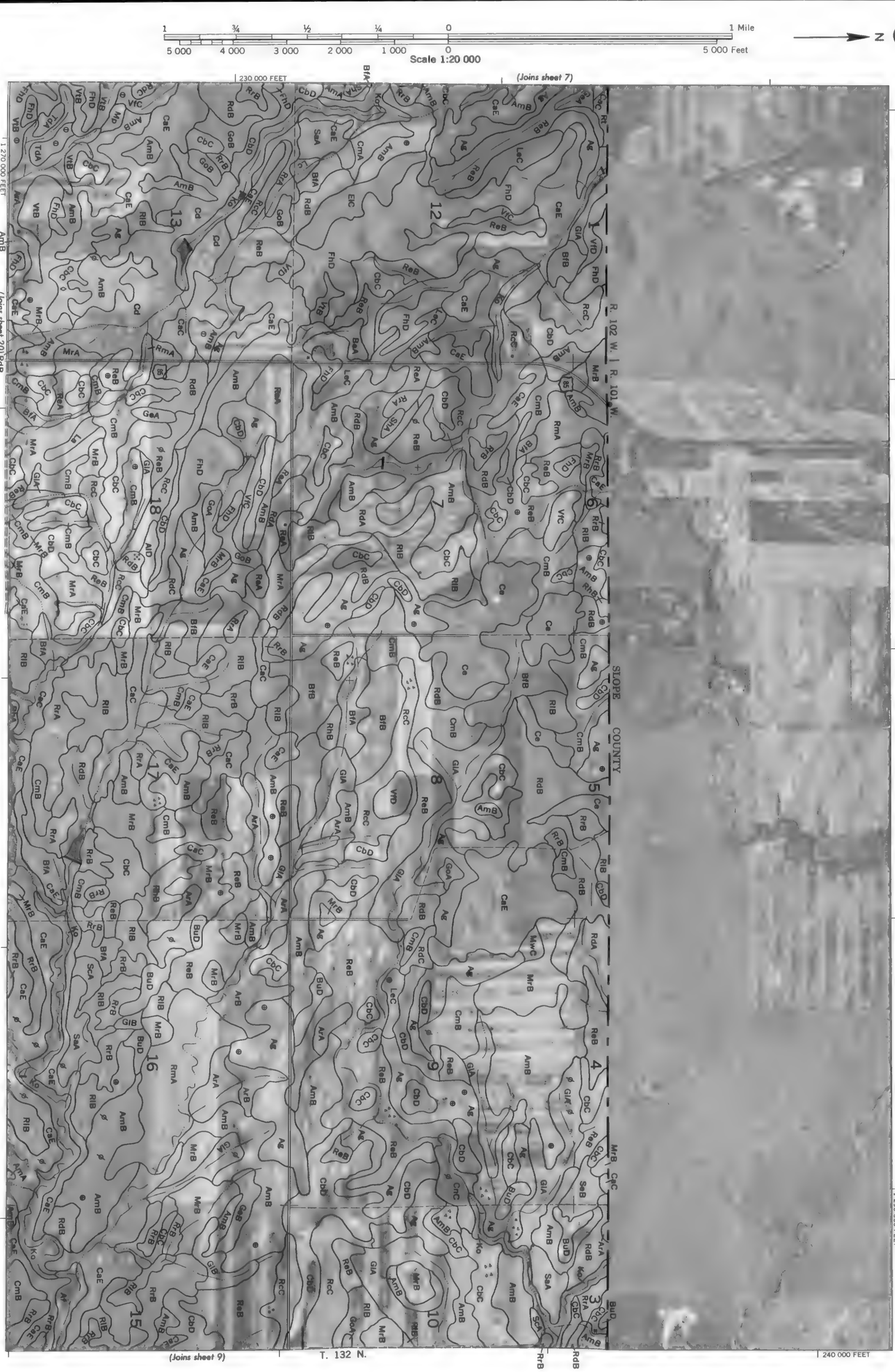
BOWMAN COUNTY, NORTH DAKOTA NO. 79

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.





BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 8

BOWMAN COUNTY, NORTH DAKOTA NO. 8

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system south zone.

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80

N

1 Mile 5 000 Feet

Scale 1:20 000

1 100 000 FEET

135 000 FEET

R. 107 W. | R. 106 W.

(Joins sheet 69)

(Joins sheet 81)

125 000 FEET

1 120 000 FEET

T. 129 N.

MONTANA

FALLON COUNTY

HARDING COUNTY SOUTH DAKOTA

BOWMAN COUNTY, NORTH DAKOTA NO. 80

Land division corners are approximately positioned on this map.

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Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 81

81

N

1 125 000 FEET

135 000 FEET

R. 106 W. | R. 105 W.

(Joins sheet 70)

T. 129 N.

(Joins sheet 80)

(Joins sheet 82)

120 000 FEET

1 145 000 FEET

HARDING COUNTY SOUTH DAKOTA

1 Mile
5 000 Feet
Scale 1:20 000
0 0
1/4 1 000
1/2 2 000
3/4 3 000
1 4 000
1 1/4 5 000

N

(Joins sheet 71)

R. 105 W.

1 170 000 FEET

T. 129 N.

130 000 FEET

(Joins sheet 83)

120 000 FEET

1 150 000 FEET

HARDING COUNTY SOUTH DAKOTA

1 Mile

5 000 Feet

Scale 1:20 000
(Joins sheet 81)

BOWMAN COUNTY, NORTH DAKOTA NO. 82

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 83

83

N

R. 105 W. | R. 104 W.

1 175 000 FEET

T. 129 N.

130 000 FEET

(Joins sheet 82)

(Joins sheet 84)

MgC (Joins sheet 72)

1 190 000 FEET

HARDING COUNTY SOUTH DAKOTA

Grand River

North Fork

1 Mile

5 000 Feet

Scale 1:20 000

BOWMAN COUNTY, NORTH DAKOTA NO. 83

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Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

N

(Joins sheet 73)

R. 104 W. | R. 103 W.

1 215 000 FEET

130 000 FEET

T. 129 N.

(Joins sheet 85)

1 Mile

5 000 Feet

Scale 1:20 000

(Joins sheet 83)

1 195 000 FEET

HARDING COUNTY SOUTH DAKOTA

BOWMAN COUNTY, NORTH DAKOTA NO. 84

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 85

85

N

R. 103 W. | R. 102 W.

T. 129 N.

(Joins sheet 74)

(Joins sheet 84)

(Joins sheet 86)

1 220 000 FEET

1 240 000 FEET

130 000 FEET

120 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

HARDING COUNTY SOUTH DAKOTA

BOWMAN COUNTY, NORTH DAKOTA NO. 85

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the North Dakota Agricultural Experiment Station.
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Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 86

86

N

R. 102 W.

T. 129 N.

(Joins sheet 75)

(Joins sheet 85)

(Joins sheet 87)

1 265 000 FEET

130 000 FEET

120 000 FEET

1 245 000 FEET

Lone Tree School

North Fork Grand River

19 20 21 22 23

30 29 28 27 26

31 32 33 34 35

1 Mile

5 000 Feet

Scale 1:20 000

0 ¼ ½ ¾ 1

0 1 000 2 000 3 000 4 000 5 000

HARDING COUNTY SOUTH DAKOTA

BOWMAN COUNTY, NORTH DAKOTA NO. 86

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

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Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 87

R. 102 W. | R. 101 W.

1 270 000 FEET

130 000 FEET

T. 129 N.

(Joins sheet 86)

(Joins sheet 76)

(Joins sheet 88)

HARDING COUNTY SOUTH DAKOTA

1 285 000 FEET

1 115 000 FEET

North Fork Grand River

North Fork Grand River

87

N

1 Mile

5 000 Feet

Scale 1:20 000

N

(Joins sheet 77)

CbC R. 101 W. | R. 100 W.

1 310 000 FEET

CbD

BOWMAN-HALEY RESERVOIR

EMERGENCY SPILLWAY

North Fork Grand River

Cane Creek

22 23 24 19 20 27 26 25 30 29 34 35 36 31 32

T. 129 N.

(Joins sheet 87)

(Joins sheet 89)

115 000 FEET

1 290 000 FEET

HARDING COUNTY SOUTH DAKOTA

125 000 FEET

1 Mile

5 000 Feet

Scale 1:20 000

1 5 000 | ¾ 4 000 | ½ 3 000 | ¼ 1 000 | 0 0

BOWMAN COUNTY, NORTH DAKOTA NO. 88

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

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BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 89

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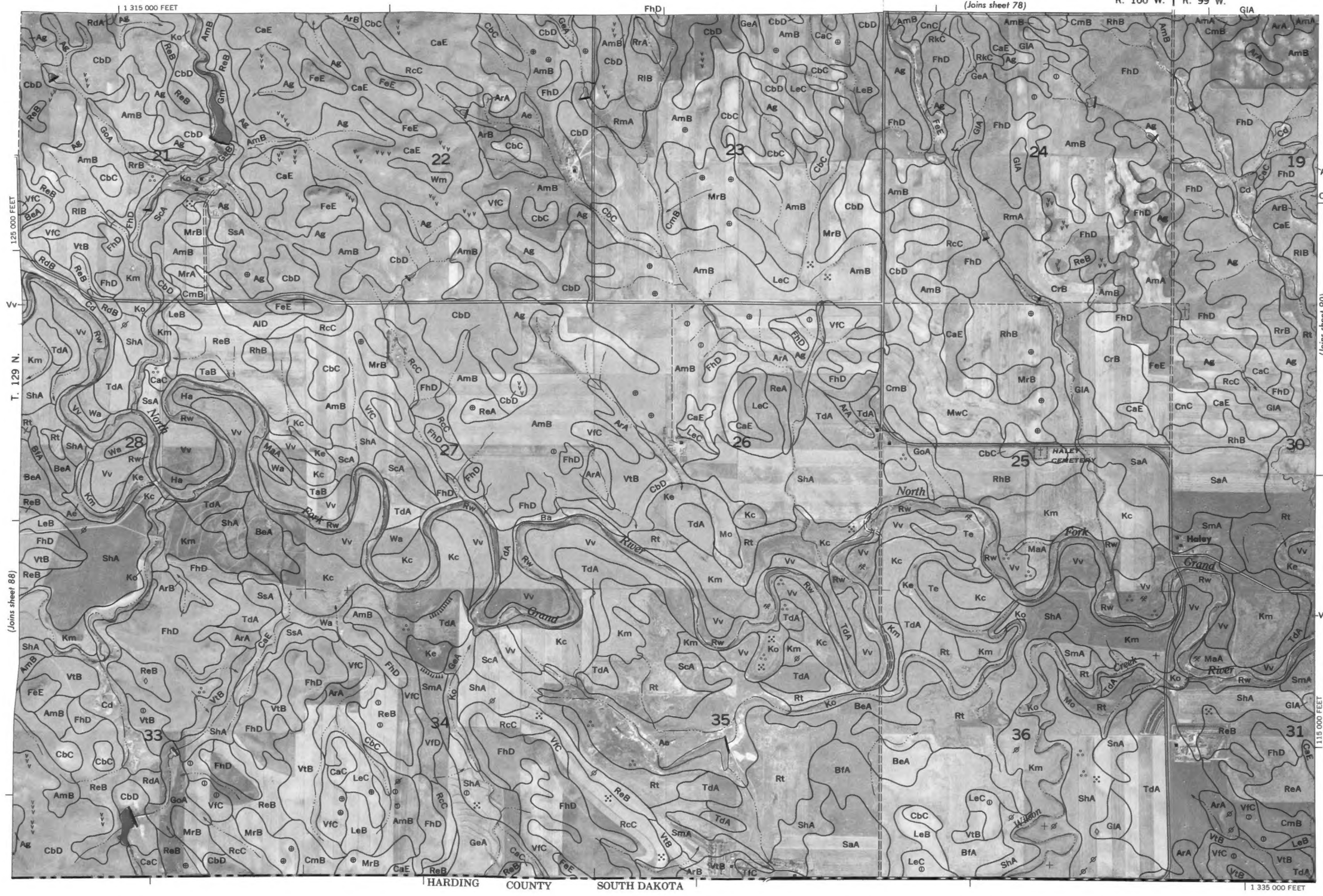
Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.
Land division corners are approximately positioned on this map.

BOWMAN COUNTY, NORTH DAKOTA NO. 89



BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 9

9

N

1 295 000 FEET

240 000 FEET

SLOPE COUNTY

R. 101 W. | R. 100 W.

T. 132 N.

(Joins sheet 8)

(Joins sheet 10)

(Joins sheet 21)

1 315 000 FEET

225 000 FEET

Cedar Creek

1 Mile

5 000 Feet

Scale 1:20 000

1 5 000 ¼ 1 000 ½ 2 000 ¾ 3 000 0 4 000

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BOWMAN COUNTY, NORTH DAKOTA NO. 9

(90)

N

(Joins sheet 79)

R. 99 W.

Km 1 360 000 FEET

T. 129 N.

(Joins sheet 89)

(Joins sheet 91)

115 000 FEET

125 000 FEET

1 Mile 5 000 Feet

Scale 1:20 000

0 0 ¼ 1 000 ½ 2 000 ¾ 4 000 1 5 000

ArB' 1 340 000 FEET

HARDING COUNTY SOUTH DAKOTA

BOWMAN COUNTY, NORTH DAKOTA NO. 90

Land division corners are approximately positioned on this map.

Photobase from 1971 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the North Dakota coordinate system, south zone.

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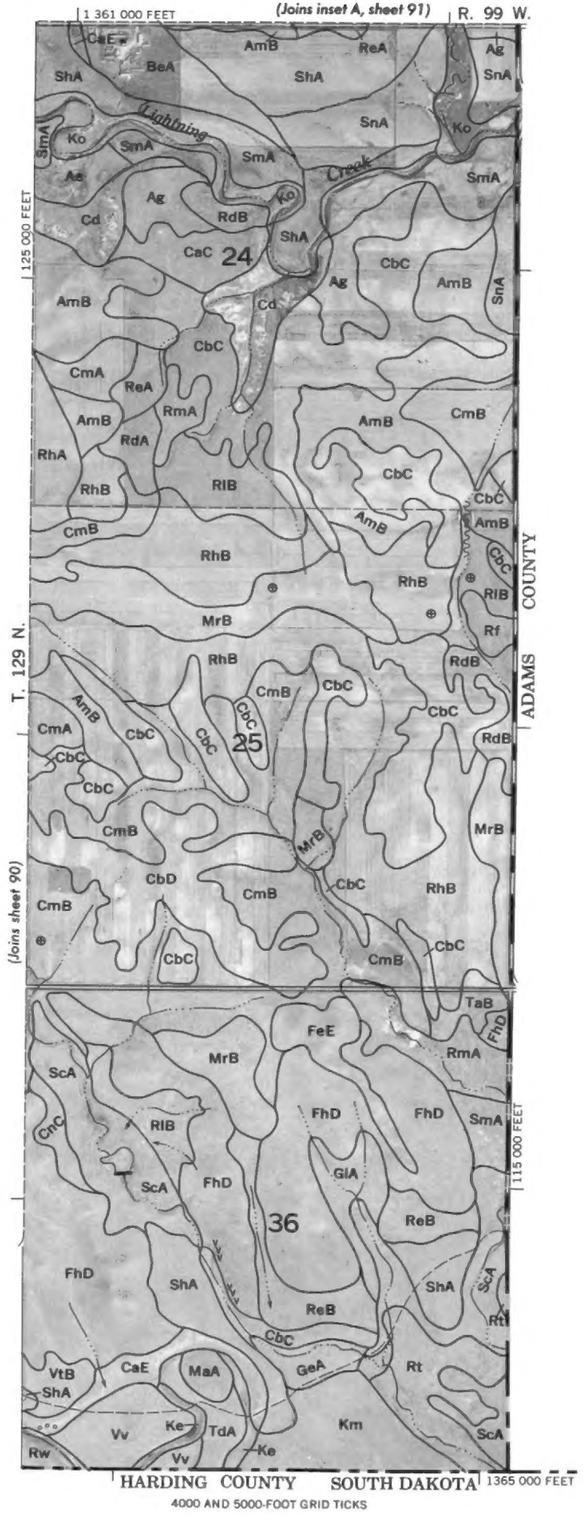
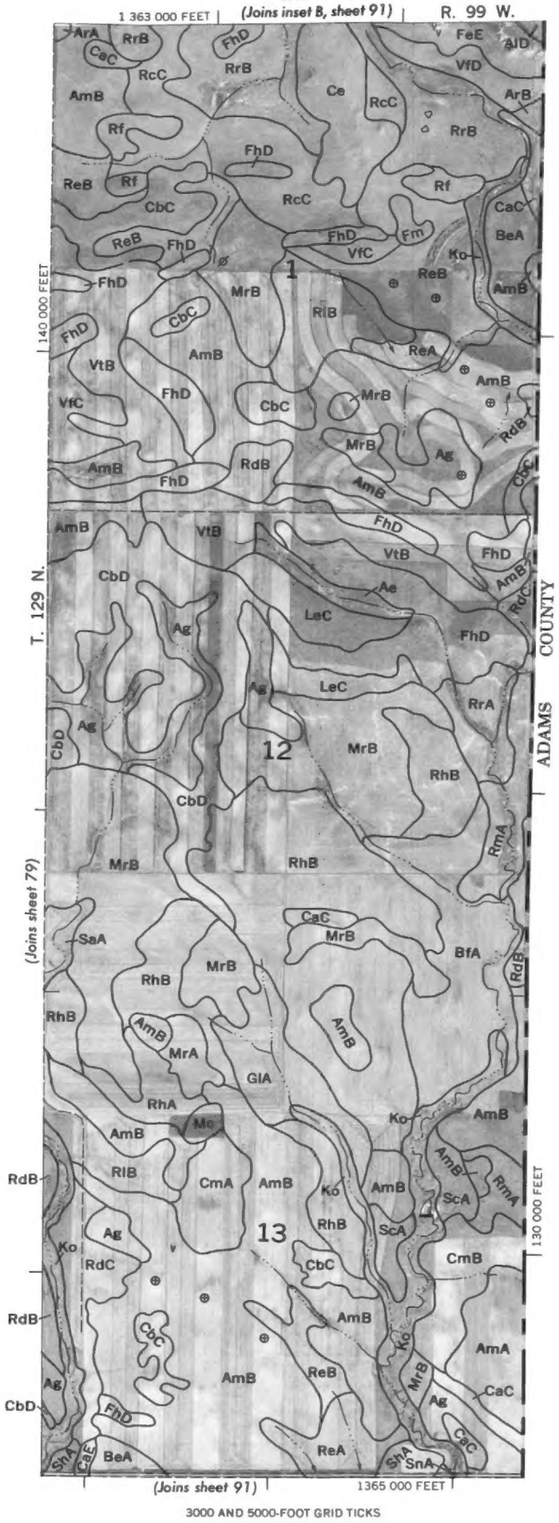
BOWMAN COUNTY, NORTH DAKOTA — SHEET NUMBER 91



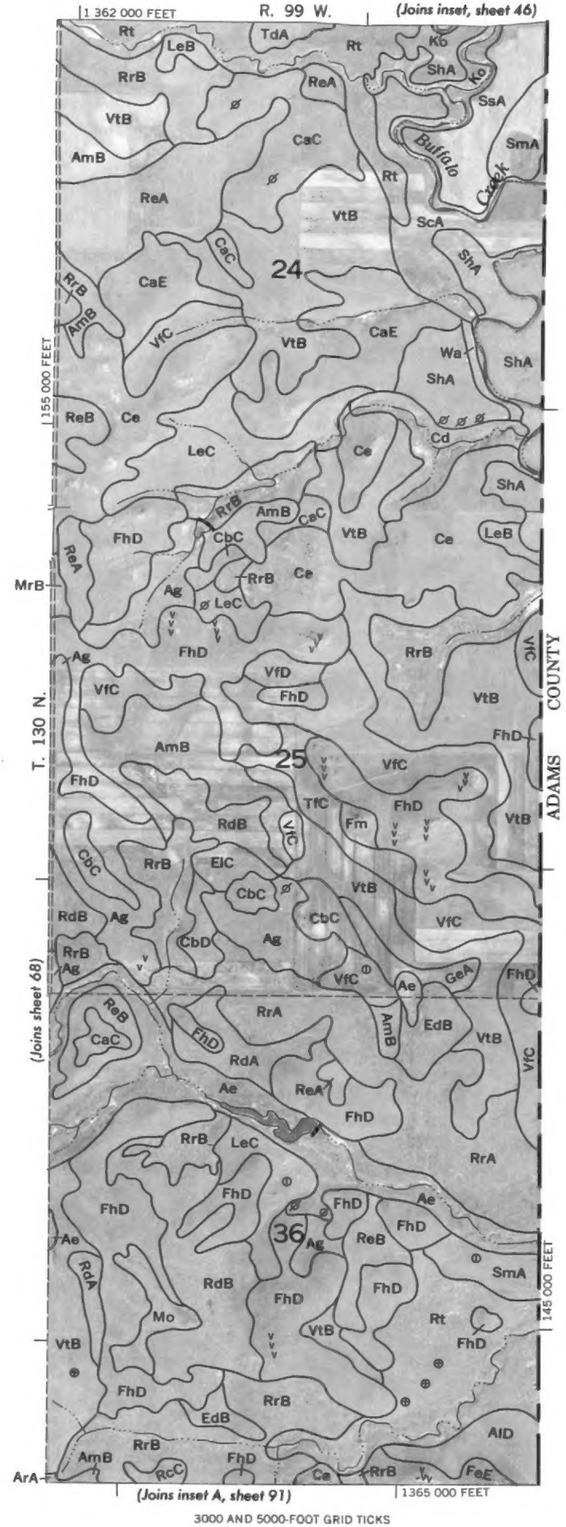
4000 AND 5000-FOOT GRID TICKS

INSET A



3000 AND 5000-FOOT GRID TICKS

INSET B



3000 AND 5000-FOOT GRID TICKS

91

N

1 Mile

5 000 Feet

Scale 1:20 000

1 5 000 ¼ 1 000 ½ 2 000 ¾ 4 000 1 3 000

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BOWMAN COUNTY, NORTH DAKOTA NO. 91